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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPELLANT:	Alex Nugent	**EXAMINER:**	Mai T Tran
SERIAL NO.:	10/748,631	**GROUP:**	2129
FILED:	12/30/2003	**ATTY DKT NO.:**	1000-1216

TITLE: APPLICATION OF HEBBIAN AND ANTI-HEBBIAN LEARNING TO NANOTECHNOLOGY-BASED PHYSICAL NEURAL NETWORKS

Please forward all correspondence to:
ORTIZ & LOPEZ, PLLC
Patent Attorneys
P.O. Box 4484
Albuquerque, NM 87196-4484

Mail Stop Appeal Brief Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF FILED UNDER C.F.R. §1.192

Dear Sir:

In response to the Office Action dated November 15, 2007 and in support of the Notice of Appeal filed on February 14, 2008, this Appeal Brief is submitted. In the Office Action dated November 15, 2007, it was indicated that the previously paid Notice of Appeal fee and Appeal Brief Fee can be applied to this new appeal. The previous Notice of Appeal Fee was $250. The previous Appeal Brief Fee was paid was also $250. The current Notice of Appeal Fee is $255 and the current Appeal Brief Fee is also $255. Thus, because the appeal fees set forth in 47 CFR 41.20 have increased since they were previously paid, Appellant is paying the difference of $5 between the increased fees and the amount previously paid. Note that $5 has already been paid with respect to the Notice of Appeal Fee.

Adjustment date: 03/13/2008 HVUONG1
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I. REAL PARTY IN INTEREST

Alex Nugent is the real party in interest in the present invention, and is also the "Appellant" entitled to bring forward this appeal. The pending application is also assigned to "KnowmTech, LLC" as recorded previously by the U.S. Patent & Trademark Office

II. RELATED APPEALS AND INTERFERENCES

There are currently no related Interferences related to the above-referenced patent application. A Notice of Appeal, however, has been filed in U.S. Patent Application Serial No. 10/969,789. A Notice of Appeal and Appeal Brief were also filed in U.S. Patent Application 10/735,934. A Notice of Appeal and Appeal Brief were also filed in U.S. Patent Application 10/748,546, which was reopened and has been allowed as of the date of this Appeal Brief.

III. STATUS OF CLAIMS

The Appellant appeals from the office action dated November 15, 2007. The office action dated November 15, 2007 was set forth in view of the previous appeal brief filed on July 25, 2007, thus reopening prosecution. New grounds of rejection are set forth in office action dated November 15, 2007.

Appellant had previously appealed the final rejection to claims 1-20 as set forth in the Final office action dated November 2, 2006 and repeated in the "Advisory Action Before the Filing of an Appeal" dated January 8, 2007. Claims 1-20 continue to constitute the appealed claims.

The application was originally filed with 20 claims. In the first office action dated June 29, 2006, claims 1-20 were rejected. Appellant responded on August 14, 2006 to the first office action with an amendment in which original claims 1, 11, 15, 16, 17, 18 were amended. In the second and final office action dated November 2, 2006, claims 1-20 were again rejected by the Examiner. The

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Appellant responded to the final office action on November 30, 2006 with a minor amendment to claim 18 and the specification and supporting remarks wherein the Appellant distinguished the cited prior art from Appellant's claims.

In an "Advisory Action Before the Filing of an Appeal" dated January 8, 2007, the Examiner denied entry of the proposed amendments and maintained the rejection of claims 1-20 and indicated that "due to the usual limited allowed time after a final office action, Examiner only responds to certain issues raised". In the Advisory Action dated January 8, 2007, the Examiner did not respond to the amendments and remarks made in the office action of November 30, 2006 with respect to the 102 and 103 rejections, but instead stated only that "applicant's arguments regarding 102 and 103 rejections have all been responded in the final office action" without addressing the arguments and amendments made by the Appellant in the office action of November 30, 2006. Appellant subsequently filed an appeal brief on July 25, 2007. Prosecution was then reopened followed by the office action dated November 15, 2007.

In response to the office action November 15, 2007, Appellant initiated a new appeal by filing the Notice of Appeal under 37 CFR 41.31 dated February 14, 2008 followed by this present appeal brief under 37 CFR 41.37. Appellant submits that previously paid notice of appeal fee and appeal brief fee apply to this new and supplemental appeal.

IV. STATUS OF AMENDMENTS

The amendment of claims 1, 11, 15, 16, 17, 18 by Appellants prior to the Final office action and the amendment to claim 8 after the Final Office Action are the claims that remain the subject of this appeal. Claims 1-20 remain pending in the appealed application.

The rejection of claims 1-20 in the office action dated November 15, 2008 is the subject of this appeal. The Appellant also requests entry of the minor amendments to both the specification and claims made in the response filed on November 30, 2006 to the final office action.

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V. SUMMARY OF CLAIMED SUBJECT MATTER

The invention claimed in claims 1-20 and independent claims 1, 11, and 17 is directed toward a system composed of a physical neural network configured utilizing nanotechnology. Dependent claims 2-10 (which are dependent upon independent claim 1), claims 12-16 (which are dependent upon independent claim 11), and claims 18-20 (which are dependent upon independent claim 17) also teach various aspects and features of such a physical neural network based on nanotechnology. The physical neural network of claims 1-20 is therefore shown and described with respect to FIGS. 1-40 and pages 18-96 of Appellant's specification. The language specifically distinguishing the independent claims 1, 11, and 17 from the art of record is provided below:

1. A system, comprising:

a physical neural network configured utilizing nanotechnology, wherein said physical neural network comprises a plurality of nanoconductors suspended and free to move about in a dielectric medium and which form neural connections between pre-synaptic and post-synaptic components of said physical neural network; and

a learning mechanism for applying Hebbian learning to said physical neural network.

FIG. 3 of Appellant's specification describes the system of FIG. 1, including nanoconductors suspended and free to move about in a dielectric medium. A description of such a feature is described in paragraphs [0087] to [0092], from page 21, line 20 to Page 23, line 14. Appellant's specification also defines and describes what constitutes nanotechnology and what constitutes a nanoconductor. For example, paragraph [0020] of Appellant's background section indicates that integrated circuits and electrical components thereof, which can be produced at a molecular and nanometer scale, include devices such as carbon nanotubes and nanowires, which essentially are nanoscale conductors ("nanoconductors"). Paragraph [0020] of Appellant's specification also teaches that nanoconductors are tiny conductive tubes (i.e., hollow) or wires (i.e., solid) with a very small size scale (e.g., 0.7 to 300 nanometers in diameter and up to 1mm in length), and that their structure and fabrication have been widely reported and are well known in the art. Paragraph [0020] additionally indicates that carbon nanotubes, for example, exhibit

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a unique atomic arrangement, and possess useful physical properties such as one-dimensional electrical behavior, quantum conductance, and ballistic electron transport. Additionally, paragraph [0023] indicates that attempts have been made to construct electronic devices utilizing nano-sized electrical devices and components. Thus, a copper ion is not a nano-sized electrical device and component such as a nanoconductor. A copper ion is neither solid nor hallow. Examples of nanoconductors are nanotubes, nanowires, etc, but not individual ions.

Hebbian learning principles are also described in Appellant's specification with respect to paragraphs [0028] to [0030] or Page 9, line 20 to Page 10, line 25. FIG. 39 and FIG. 40 of Appellant's specification, paragraphs [00319] to [00323], page 93, line 24 to page 95, line 29 also describes Hebbian and anti-Hebbian learning and hence a learning mechanism.

11. A <u>system</u>, comprising:

a <u>physical neural network</u> configured utilizing <u>nanotechnology</u>, wherein said physical neural network comprises a <u>plurality</u> of <u>nanoconductors</u> suspended and <u>free</u> to <u>move about</u> in a <u>dielectric medium</u> and which form <u>neural connections</u> between <u>pre-synaptic</u> and <u>post-synaptic</u> components of said physical neural network; and

a <u>learning mechanism</u> for <u>applying</u> <u>Hebbian</u> <u>learning</u> to said physical neural network wherein said learning mechanism utilizes a <u>voltage gradient</u> <u>or</u> <u>pre-synaptic</u> and <u>post-synaptic</u> <u>frequencies</u> thereof to implement <u>Hebbian</u> <u>or</u> <u>anti-Hebbian</u> <u>plasticity</u> within said physical neural network.

FIG. 3 of Appellant's specification describes the system of FIG. 1, including nanoconductors suspended and free to move about in a dielectric medium. A description of such a feature is described in paragraphs [0087] to [0092], from page 21, line 20 to Page 23, line 14. Hebbian learning principles are also described in Appellant's specification with respect to paragraphs [0028] to [0030] or Page 9, line 20 to Page 10, line 25. FIG. 39 and FIG. 40 of Appellant's specification, paragraphs [00319] to [00323], page 93, line 24 to page 95, line 29 also describes Hebbian and anti-Hebbian learning and hence a learning mechanism.

17. A <u>system</u>, comprising:

a <u>plurality</u> of <u>molecular conductors</u> <u>disposed in and free to move about</u> <u>within</u> a <u>dielectric medium</u> comprising a <u>dielectric solvent</u> or a <u>dielectric solution</u>;

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at least one input electrode in contact with said dielectric medium; and

at least one output electrode in contact with said dielectric medium, wherein said plurality of molecular conductors form physical neural connections when said dielectric medium is exposed an electric field across said at least one input electrode and said at least one output electrode, such that said physical neural connections can be strengthened or weakened depending upon a strengthening or weakening of said electric field or an alteration of a frequency thereof.

FIG. 3 of Appellant's specification describes the system of FIG. 1, including nanoconductors suspended and free to move about in a dielectric medium. A description of such a feature is described in paragraphs [0087] to [0092], from page 21, line 20 to Page 23, line 14. Hebbian learning principles are also described in Appellant's specification with respect to paragraphs [0028] to [0030] or Page 9, line 20 to Page 10, line 25. FIG. 39 and FIG. 40 of Appellant's specification, paragraphs [00319] to [00323], page 93, line 24 to page 95, line 29 also describes Hebbian and anti-Hebbian learning and hence a learning mechanism. FIG. 40 of Appellant's specification, and paragraph [00322], lines 1-7, page 95 also describes molecular conductors (e.g., nanoconductors). The strengthening or weakening of electric field or alteration of a frequency is demonstrated by FIGS. 35-36.

The language specifically distinguishing the dependent claims 2-10 from the art of record is provided below:

2. The system of claim 1 wherein said learning mechanism utilizes a voltage gradient to implement Hebbian plasticity within said physical neural network.

3. The system of claim 1 wherein said learning mechanism utilizes voltage gradient dependencies associated with physical neural network to implement Hebbian learning within said physical neural network.

4. The system of claim 1 wherein said learning mechanism utilizes pre-synaptic and post-synaptic frequencies to provide Hebbian learning within said physical neural network.

5. The system of claim 1 wherein said learning mechanism utilizes a voltage gradient to implement anti-Hebbian plasticity within said physical neural network.

6. The system of claim 1 wherein said learning mechanism utilizes voltage gradient dependencies associated with physical neural network to implement anti-Hebbian learning within said physical neural network.

7. The system of claim 1 wherein said learning mechanism utilizes pre-synaptic and post-synaptic frequencies to provide anti-Hebbian learning within said physical neural network.

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8. The system of claim 1 wherein said plurality of nanoconductors includes nanoconductors comprising nanotubes.

9. The system of claim 1 wherein said plurality of nanoconductors includes nanoconductors comprising nanowires.

10. The system of claim 1 wherein said plurality of nanoconductors includes nanoconductors comprising nanoparticles.

The use of a voltage gradient to implement Hebbian plasticity within Appellant's physical neural network is described, for example, in Appellant's specification in paragraph [0036], pg. 12, lines 4-7; paragraph [00272], pg. 79, lines 1-2; paragraph [00297], pg. 87, lines 9-14; paragraph [00321], pg. 94, lines 4-29 with respect to FIG. 39. The use of voltage gradient dependencies is disclosed in Appellant's specification at, for example, paragraph [00322], pg. 95, lines 10-17 with respect to FIG. 40; paragraph [00323], pg. 95, lines 24-29. The use of pre-synaptic and post-synaptic frequencies to provide Hebbian learning within the physical neural network is also disclosed within a number of locations within Appellant's specification. For example, paragraph [03222], pg. 95, lines 12-15 discusses such features, along with paragraph [03223], pg. 95, lines 23-29 with respect to FIG. 40.

FIGS. 39-40 also illustrate both Hebbian and anti-Hebbian learning rules. The use of nanowires, nanotubes and other types of nanoparticles is also discussed in Appellant's specification at, for example, paragraph [0087], pg. 21, lines 25-27; paragraph [0088], pg. 22, lines 1-9. Various types of nanoconductors or what constitutes such nanoconductors are discussed here. Examples include carbon nanotubes and even DNA. Paragraph [0088] further indicates that the term "nanoparticle" can be utilized interchangeably with the term "nanoconductor" and that the term "nanoparticle" can refer simply to a particular type of nanoconductors, such as, for example, a carbon nanoparticle, or another type of nanoconductors, such as, for example, a carbon nanotube or a carbon nanowire. In general, paragraph [0088] indicates that devices that conduct electricity and have dimensions on the order of nanometers can be referred to as nanoconductors.

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The language specifically distinguishing dependent claims 12-16 from the art of record is provided below:

12. The system of claim 11 wherein said plurality of nanoconductors includes nanoconductors comprising nanotubes.

13. The system of claim 11 wherein said plurality of nanoconductors includes nanoconductors comprising nanowires.

14. The system of claim 11 wherein said plurality of nanoconductors includes nanoconductors comprising nanoparticles.

15. The system of claim 11 wherein said dielectric medium comprises a dielectric liquid.

16. The system of claim 15 wherein said plurality of nanoconductors form physical neural connections when said dielectric medium is exposed to an electric field, such that said physical neural connections can be strengthened or weakened depending upon a strengthening or weakening of said electric field or an alteration of a frequency thereof.

Regarding nanowires, nanoparticles, refer to the cited sections of Appellant's specification indicated above. In the interest of brevity, the reference to these sections will not be repeated here. Regarding the use of a dielectric liquid, see for example, paragraph [00119], pg.21, line 14. The aspect of nanoconductors forming physical neural connections when said dielectric medium is exposed to an electric field, such that said physical neural connections can be strengthened or weakened depending upon a strengthening or weakening of said electric field or an alteration of a frequency thereof is taught by Appellant's FIGS. 1-40 and the related paragraphs thereof of Appellant's specification.

The language specifically distinguishing dependent claims 18-20 from the art of record is provided below:

18. The system of claim 17 further comprising a physical neural network comprising said plurality of molecular conductors disposed within a dielectric medium comprising a dielectric solvent or a dielectric solution, said at least one input electrode in contact with said dielectric medium, and said at least one output electrode in contact with said dielectric medium.

19. The system of claim 18 further comprising a learning mechanism for applying Hebbian learning to said physical neural network wherein said learning mechanism utilizes a voltage gradient or pre-synaptic and post-synaptic frequencies thereof to implement Hebbian or anti-Hebbian plasticity within said physical neural network.

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20. The system of claim 18 wherein said physical neural network is configured as an integrated circuit chip utilizing nanotechnology.

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FIG. 3 of Appellant's specification describes the system of FIG. 1, including nanoconductors suspended and free to move about in a dielectric medium. A description of such a feature is described in paragraphs [0087] to [0092], from page 21, line 20 to Page 23, line 14. Appellant's specification also defines and describes what constitutes nanotechnology and what constitutes a nanoconductor. For example, paragraph [0020] of Appellant's background section indicates that integrated circuits and electrical components thereof, which can be produced at a molecular and nanometer scale, include devices such as carbon nanotubes and nanowires, which essentially are nanoscale conductors ("nanoconductors"). Paragraph [0020] of Appellant's specification also teaches that nanoconductors are tiny conductive tubes (i.e., hollow) or wires (i.e., solid) with a very small size scale (e.g., 0.7 to 300 nanometers in diameter and up to 1mm in length), and that their structure and fabrication have been widely reported and are well known in the art. Paragraph [0020] additionally indicates that carbon nanotubes, for example, exhibit a unique atomic arrangement, and possess useful physical properties such as one-dimensional electrical behavior, quantum conductance, and ballistic electron transport. Additionally, paragraph [0023] indicates that attempts have been made to construct electronic devices utilizing nano-sized electrical devices and components. Thus, a copper ion is not a nano-sized electrical device and component such as a nanoconductor. A copper ion is neither solid nor hallow. Examples of nanoconductors are nanotubes, nanowires, etc, but not individual ions.

Hebbian learning principles are also described in Appellant's specification with respect to paragraphs [0028] to [0030] or Page 9, line 20 to Page 10, line 25. FIG. 39 and FIG. 40 of Appellant's specification, paragraphs [00319] to [00323], page 93, line 24 to page 95, line 29 also describes Hebbian and anti-Hebbian learning and hence a learning mechanism.

FIGS. 39-40 also illustrate both Hebbian and anti-Hebbian learning rules. The use of nanowires, nanotubes and other types of nanoparticles is also discussed

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in Appellant's specification at, for example, paragraph [0087], pg. 21, lines 25-27; paragraph [0088], pg. 22, lines 1-9. Various types of nanoconductors or what constitutes such nanoconductors are discussed here. Examples include carbon nanotubes and even DNA. Paragraph [0088] further indicates that the term "nanoparticle" can be utilized interchangeably with the term "nanoconductor" and that the term "nanoparticle" can refer simply to a particular type of nanoconductors, such as, for example, a carbon nanoparticle, or another type of nanoconductors, such as, for example, a carbon nanotube or a carbon nanowire. In general, paragraph [0088] indicates that devices that conduct electricity and have dimensions on the order of nanometers can be referred to as nanoconductors.

For a full understanding and appreciation of the concepts behind Appellant's claims, it is suggested that one read the entire specification in its entirety.

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VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Issues #1 to #10 below constitute the grounds of rejection to be reviewed on appeal. A concise statement of each ground of rejection presented for review is listed below with respect to Issues #1 to #10.

-- ISSUE #1: Whether the requirement under 37 C.F.R. 1.56 and 1.105 is proper.

-- ISSUE #2: Whether claims 1, 9, 10 are unpatentable under 35 U.S.C 103(a) over McHardy et al (U.S. Patent No. 5,315,162), hereinafter "McHardy", and further in view of Liaw et al (U.S. Patent No. 6,363,369), hereinafter "Liaw"

-- ISSUE #3: Whether claims 2-7 are unpatentable under 35 U.S.C 103(a) over McHardy in view of Liaw, and further in view of Nervegna et al. (U.S. Patent No. 6,687,686), hereinafter Nervegna.

-- ISSUE #4: Whether claim 8 is unpatentable under 35 U.S.C 103(a) over McHardy in view of Liaw, and further in view of Brandes et al. (U.S. Patent No. 6,445,006), hereinafter Brandes.

-- ISSUE #5: Whether claim 11 is unpatentable under 35 U.S.C 103(a) over McHardy in view of Liaw, and further in view of Nervegna.

-- ISSUE #6: Whether claims 13, 14, 15, 16 is unpatentable under 35 U.S.C 103(a) over McHardy in view of Liaw, and further in view of Nervegna.

-- ISSUE #7: Whether claims 12 is unpatentable under 35 U.S.C 103(a) over McHardy in view of Liaw, and further in view of Nervegna and Brandes.

-- ISSUE #8: Whether claims 17-18 and 20 are anticipated by McHardy.

-- ISSUE #9: Whether claim 19 is unpatentable under 35 U.S.C 103(a) over McHardy in view of Liaw.

-- ISSUE #10: Whether the double patenting rejection to claims 1, 11, 15, and 16 is overcome by the terminal disclaimer included herewith.

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VII. ARGUMENT

APPLICABLE LEGAL STANDARDS

37 C.F.R. § 1.105 Requirements for information

The relevant statutes cited requiring "detailed laboratory data" is 37 C.F.R. § 1.105, Requirements for information, which indicates the following:

(a)

(1) In the course of examining or treating a matter in a pending or abandoned application filed under 35 U.S.C. 111 or 371 (including a reissue application), in a patent, or in a reexamination proceeding, the examiner or other Office employee may require the submission, from individuals identified under § 1.56(c), or any assignee, of such information as may be reasonably necessary to properly examine or treat the matter, for example:

(i) *Commercial databases*: The existence of any particularly relevant commercial database known to any of the inventors that could be searched for a particular aspect of the invention.

(ii) *Search*: Whether a search of the prior art was made, and if so, what was searched.

(iii) *Related information*: A copy of any non-patent literature, published application, or patent (U.S. or foreign), by any of the inventors, that relates to the claimed invention.

(iv) *Information used to draft application*: A copy of any non-patent literature, published application, or patent (U.S. or foreign) that was used to draft the application.

(v) *Information used in invention process*: A copy of any non-patent literature, published application, or patent (U.S. or foreign) that was used in the invention process, such as by designing around or providing a solution to accomplish an invention result.

(vi) *Improvements*: Where the claimed invention is an improvement, identification of what is being improved.

(vii) *In Use:* Identification of any use of the claimed invention known to any of the inventors at the time the application was filed notwithstanding the date of the use.

(viii) *Technical information known to Appellant*. Technical information known to Appellant concerning the related art, the disclosure, the claimed subject matter, other factual information pertinent to patentability, or concerning the accuracy of the examiner's stated interpretation of such items.

(2) Where an assignee has asserted its right to prosecute pursuant to § 3.71(a) of this chapter, matters such as paragraphs (a)(1)(i), (iii), and (vii) of this section may also be applied to such assignee.

(3) Requirements for factual information known to Appellant may be presented in any appropriate manner, for example:

(i) A requirement for factual information;

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(ii) Interrogatories in the form of specific questions seeking Appellant's factual knowledge; or

(iii) Stipulations as to facts with which the Appellant may agree or disagree.

(4) Any reply to a requirement for information pursuant to this section that states either that the information required to be submitted is unknown to or is not readily available to the party or parties from which it was requested may be accepted as a complete reply.

(b) The requirement for information of paragraph (a)(1) of this section may be included in an Office action, or sent separately.

(c) A reply, or a failure to reply, to a requirement for information under this section will be governed by §§ 1.135 and 1.136.

35 U.S.C. §102(b)

The relevant statute cited in rejecting Appellants' claims is 35 U.S.C. §102(b), Conditions for patentability; novelty and loss of right to patent. Section (b) is the basis of the rejections rendered by the examiner. Under 35 U.S.C. §102, section (b), a person is be entitled to a patent unless:

> (b) - the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States ---

Prima Facie Anticipation

The Commissioner of Patents and Trademarks, acting through examining officials, bears the initial duty of supplying the factual basis supporting a rejection of a patent application, including a rejection based on anticipation. *In re Warner*, 379 F.2d 1011, 154 USPQ 173, 178 (C.C.P.A. 1967), *cert. denied*, 389 U.S. 1057 (1968). The courts have interpreted this initial duty as placing on the Commissioner and the examiner the burden of presenting a *prima facie* case of anticipation. *See In re King*, 801 F.2d 1324, 1327, 231 USPQ 136, 138-39 (Fed. Cir. 1986); *In re Wilder*, 429 F.2d 447, 450, 166 USPQ 545, 548 (C.C.P.A. 1970). As stated by the Board in *In re Skinner*, 2 USPQ 2d 1788, 1788-9 (B.P.A.I. 1986), "[i]t is by now well settled that the burden of establishing a *prima facie* case of anticipation resides with the Patent and Trademark Office."

A general definition of *prima facie* unpatentability is provided at 37 C.F.R. §1.56(b)(2)(ii):

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> A *prima facie* case of unpatentability is established when the information *compels a conclusion* that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability. (Emphasis added.)

"Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration." *W.L. Gore & Associates v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303, 313 (Fed. Cir. 1983) (citing *Soundscriber Corp. v. United States*, 360 F.2d 954, 960, 148 USPQ 298, 301 (Ct. Cl.), *adopted*, 149 USPQ 640 (Ct. Cl. 1966)), *cert. denied*, 469 U.S. 851 (1984). Thus, to anticipate the Appellants' claims, either *Strandwitz* or *Mann* must disclose each element of the respective claims that they are being recited for. "There must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention." *Scripps Clinic & Research Foundation v. Genentech, Inc.*, 927 F.2d 1565, 18 USPQ 2d 1001, 1010 (Fed. Cir. 1991).

To overcome the anticipation rejection, the Appellants need only demonstrate that not all elements of a *prima facie* case of anticipation have been met, *i. e.*, show that *Strandwitz* or *Mann* fails disclose every element in each of the Appellants' claims associated with the relevant reference used for their rejection. "If the examination at the initial state does not produce a prima face case of unpatentability, then without more the applicant is entitled to grant of the patent." *In re Oetiker*, 977 F.2d 1443, 24 USPQ 2d 1443, 1444 (Fed. Cir. 1992).

M.P.E.P. § 2131:

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference". *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 U.S.P.Q. 2d 1051, 1053 (Fed. Cir. 1987). . . . "The identical invention must be shown in as complete detail as is contained in the . . . claim." *Richardsons v. Suzuki Motor Co.*, 868, F.2d 1226, 1236, 9 U.S.P.Q. 2d 1913, 1920 (Fed. Cir. 1989)

35 U.S.C. §103(a)

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The relevant statute cited in rejecting Appellants' claims is 35 U.S.C. §103(a),

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Requirements for Prima Facie Obviousness

The obligation of the examiner to go forward and produce reasoning and evidence in support of obviousness is clearly defined at M.P.E.P. §2142:

> "The examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. If the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness."

The U.S. Supreme Court ruling of April 30, 2007 (*KSR Int'l v. Teleflex Inc.*) states:

> "The TSM test captures a helpful insight: A patent composed of several elements is not proved obvious merely by demonstrating that each element was, independently, known in the prior art. Although common sense directs caution as to a patent application claiming as innovation the combination of two known devices according to their established functions, it can be important to identify a reason that would have prompted a person of ordinary skill in the art to combine the elements as the new invention does."
>
> "To facilitate review, this analysis should be made explicit."

The U.S. Supreme Court ruling states that it is important to identify a *reason* that would have prompted a person to combine the elements and to make that analysis *explicit*. MPEP §2143 sets out the further basic criteria to establish a *prima facie* case of obviousness:

1. a reasonable expectation of success; and

2. the teaching or suggestion of <u>all</u> the claim limitations by the prior art reference (or references when combined).

It follows that in the absence of such a *prima facie* showing of obviousness by the Examiner (assuming there are no objections or other grounds for rejection) and

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of a *prima facie* showing by the Examiner of a *reason* to combine the references, an applicant is entitled to grant of a patent. Thus, in order to support an obviousness rejection, the Examiner is obliged to produce evidence compelling a conclusion that the basic criterion has been met.

APPELLANT'S ARGUMENTS REGARDING ISSUE #1 - ARGUMENTS IN SUPPORT OF THE PROPOSITION THAT THE REQUIREMENT FOR INFORMATION UNDER 37 C.F.R. § 1.56(c) and 1.105 WAS NOT PROPER:

Appellant submits that the Examiner's requirement for information under 37 CFR 1.56(c) and 1.105 for information was not proper, given that Appellant's filing of Appellant's application constituted a "constructive reduction to practice". That is, a constructive reduction to practice occurred when Appellant's present patent application on the claimed invention was filed. The filing of Appellant's patent application served as conception and constructive reduction to practice of the subject matter described in the application. Thus, Appellant need not provide evidence of either conception or actual reduction to practice when relying on the content of the patent application. *Hyatt v. Boone*, 146 F.3d 1348, 1352, 47 USPQ2d 1128, 1130 (Fed. Cir.1998). Additionally, constructive reduction to practice occurred upon the filing of Appellant's patent application on the claimed invention." *Brunswick Corp. v. U.S.*, 34 Fed. Cl. 532, 584 (1995).

The Examiner seems to be shifting the issue away from the fact that a constructive reduction to practice existed at the time of filing in attempt to assert a requirement under 37 CFR 1.56(c) and 1.105 as an attempt to allege that reduction to practice, and hence, a constructive reduction practice did not occur. The Examiner argued under 37 CFR §§ 1 1.105, the Appellant is required to submit laboratory notebooks and test data including pictures of test setup to demonstrate that the claimed invention has been reduced to practice.

In response, the Appellant submits that it is not necessary to submit such information, because the present invention has already been constructively reduced to practice. Appellant relies on MPEP 2138.05 as follows: "Reduction to practice may be an actual reduction or a constructive reduction to practice which occurs when a patent application on the claimed invention is filed. The filing of a patent application serves as conception and constructive reduction to practice of the subject matter described in the application. Thus, the inventor need not provide evidence of either conception or actual reduction to practice when relying on the content of the patent application." *Hyatt v. Boone*, 146 F.3d 1348, 1352, 47 USPQ2d 1128, 1130 (Fed. Cir. 1998).

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The filing of Appellant's present patent application therefore constitutes evidence of a reduction to practice, being a constructive reduction to practice. Appellant further notes that under 37 CFR 1.105 (a)(4), a reply to a requirement for information pursuant to this section that states either that the information required to be submitted is unknown to or is not readily available to the party or parties from which it was requested may be accepted as a complete reply. Thus, the Appellant does not have laboratory notebooks and test data due available. It is believed that this statement is sufficient for purposes of reply to the requirement for information under 37 CFR §§ 1.56(c) and 1.105. Such information is simply not readily available to the Examiner because it is not available to the Appellant. As indicated above, however, Appellant already constructively reduced the invention to practice at the time of the filing of the application.

Appellant further notes, however, that under 37 CFR 1.105(a)(1)(viii), the information requested by the Examiner for purposes of the requirement of information under 37 CFR 1.105 as reasonably necessary to properly examine or treat the matter can include *Technical information known to Appellant*. Technical information known to Application concerning the related art, the disclosure, the claimed subject matter, other factual information pertinent to patentability, or concerning the accuracy of the examiner's stated interpretation of such items. As such, the Appellant invites the Examiner to review the following nanotechnology-based neural network patents, which constitute technical information related to the present application, and which have been issued by the U.S. Patent & Trademark Office. These issued patents are indicated as follows and listed in Appendix IX, and satisfy the requirements of 37 CFR 1.105(a)(1)(viii) and hence 37 CFR 1.105:

U.S. Patent No.	Title
7,107,252	Pattern recognition utilizing a nanotechnology-based neural network
7,039,619	Utilized nanotechnology apparatus using a neural network, a solution and a connection gap
7,028,017	Temporal summation device utilizing nanotechnology
6,995,649	Variable resistor apparatus formed utilizing nanotechnology
6,889,216	Physical neural network design incorporating nanotechnology

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Appellant is providing the patent numbers and titles of these patents only in the interest of Brevity. For a complete copy of each of these documents, Appellant notes that copies of these patents are readily available via the U.S. Patent & Trademark Office patent database. If the Examiner is seeking technical information related to a neural network based on nanotechnology and nanoconductors in a dielectric solution, the Appellant suggests that the Examiner review these patents as a part of his requirement for information under 37 CFR §§ 1.56(c) and 1.105, because these patents constitute technical information related to the present application and also because such patents demonstrate that other types of neural networks based on nanotechnology have been issued patents by the U.S. Patent & Trademark Office, thereby also establishing the state of the art of nanotechnology-based neural networks and related devices and methods. Thus, the requirement for information under 37 CFR §§ 1.56(c) and 1.105 is satisfied in that information concerning test data is not readily available to the Appellant for the Examiner and in the alternative, the above referenced related issued patents satisfy the request for information 37 CFR 1.105(a)(1)(viii).

APPELLANT'S ARGUMENTS REGARDING ISSUE #2 - ARGUMENTS IN SUPPORT OF PATENTABILITY OF CLAIMS 1, 9, 10:

Claims 1, 9, 10 are patentable over McHardy in view of Liaw.

In the Office Action dated November 15, 2007, the Examiner rejected claims 1, 9 and 10 under 35 U.S.C. 103(a) as being unpatentable over McHardy and further in view of Liaw.

Claims 1, 9, and 10 as amended on August 14, 2006, and entered by the USPTO, read as follows:

1. A system, comprising:
    a physical neural network configured utilizing nanotechnology, wherein said physical neural network comprises a plurality of nanoconductors suspended and free to move about in a dielectric medium and which form neural connections between pre-synaptic and post-synaptic components of said physical neural network; and
    a learning mechanism for applying Hebbian learning to said physical neural network.

9. The system of claim 1 wherein said plurality of nanoconductors includes nanoconductors comprising nanowires.

10. The system of claim 1 wherein said plurality of nanoconductors includes nanoconductors comprising nanoparticles.

Regarding claim 1, the Examiner argued that McHardy teaches a system, comprising:

a physical neural network configured utilizing nanotechnology (*the Examiner cited McHardy, the abstract, lines 1-4, column 1; lines 8-12; lines 46-55; and col. 4, lines 8-30, and argued that McHardy discloses copper ions which have dimensions on the atomic and molecular scale and that this reads on the "nanotechnology" of Appellant's claims*), wherein said physical neural network comprises a plurality of nanoconductors suspended and free to move about in a dielectric medium and which form neural connections between pre-synaptic and post-synaptic components of said physical neural network (*the Examiner cited McHardy, the abstract; col. 1, lines 29-55; col. 2, lines 45-54; col. 3, lines 44-62; col. 4, lines 8-45; FIGS. 1-3; and argued that the dissolved copper ions of McHardy will form a conductive path between the terminals creating the connections of neural network. The Examiner argued that the moisture film will serve as a*

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dielectric, asserting that it serves as an insulating medium intervening between two conductors (the Examiner argued the "input" and "output" of the synapse). The Examiner further argued that the carbon channel or carbon deposited layer that contains the moisture film is also a dielectric. The Examiner asserted that the precipitation of copper ions will grow copper whiskers (asserting that the whiskers constitute nanoconductors), which will be disposed in the dielectric medium. The Examiner further argued that pre-synaptic components are the input terminals and post-synaptic components are the output terminals).

The Examiner admitted that McHardy does not teach a learning mechanism for applying Hebbian learning to the physical neural network. The Examiner argued, however, that Liaw teaches a learning mechanism for applying Hebbian learning to a physical neural network and cited Liaw, col. 13, lines 5-18 in support of this argument.

The Examiner asserted that it would have been obvious at the time the invention was made to one of ordinary skill in the art to combine the teachings of McHardy with the learning mechanism for applying Hebbian learning as taught by Liaw for the purpose of having means to govern how the neural network is to adapt its connections to product a correct input-output mapping.

Regarding claim 9, the Examiner argued that McHardy in combination with Liaw teaches the system of claim 1 wherein said plurality of nanoconductors includes nanoconductors comprising nanowires (*the Examiner referred to McHardy, col. 1, lines 46-55, col. 4, lines 8-30, col. 7, and lines 10-14 and argued that metallic whiskers are nanowires*).

Regarding claim 10, the Examiner argued that McHardy in combination with Liaw teach the system of claim 1 wherein said plurality of nanoconductors includes nanoconductors comprising nanoparticles (*the Examiner referred to McHardy, col. 5, lines 10-40, and asserted that ion insertion compounds are nanoparticles*).

The Appellant respectfully disagrees with this assessment. There are a number of significant differences between McHardy and all of the claim limitations of Appellant's claims 1, 9, and 10 that render Appellant's invention non-obvious over McHardy in combination with Liaw. First, Appellant notes that the McHardy

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reference is not a device based on nanotechnology as that term is taught by Appellant's invention and as that term is known in the art.

Appellant's specification and claims that Appellant's invention is directed toward claim limitations that include nanotechnology (nanometer-scale) components, such as nanoconductors and nanoconnections in the context of a physical neural network synapse chip based on nanotechnology. Examples of nanoconductors as taught by Appellant's specification and as such components are generally known and thought of in the art are nanometer scale devices such as carbon nanotubes, carbon nanowires, gold nanowires, and even DNA. An individual "ion" (or "copper ion") as argued by the Examiner in this sense is not "nanotechnology". If that were the case, then by this logic, EVERYTHING that utilizes an ion would constitute nanotechnology.

Appellant's specification Page 6, Line 7 indicates the following:

> The term "Nanotechnology" generally refers to nanometer-scale manufacturing processes, materials and devices, as associated with, for example, nanometer-scale lithography and nanometer-scale information storage.

Appellant's specification at paragraph [0020] further indicates the following:

> [0020]Integrated circuits and electrical components thereof, which can be produced at a molecular and nanometer scale, include devices such as carbon nanotubes and nanowires, which essentially are nanoscale conductors ("nanoconductors"). Nanoconductors are tiny conductive tubes (i.e., hollow) or wires (i.e., solid) with a very small size scale (e.g., 0.7 to 300 nanometers in diameter and up to 1mm in length). Their structure and fabrication have been widely reported and are well known in the art. Carbon nanotubes, for example, exhibit a unique atomic arrangement, and possess useful physical properties such as one-dimensional electrical behavior, quantum conductance, and ballistic electron transport.

Appellant's specification provides further evidence of what constitutes "nanoconductors" as that term is known in the art and taught by Appellant's specification. For example, paragraphs [0088] to [0089] of Appellant's specification indicates the following:

> [0088] to [0089] "...Examples of nanoconductors include devices such as, for example, nanowires, nanotubes, and nanoparticles...Nanoconnections 304, which are analogous to biological synapses, can be composed of electrical conducting material (i.e., nanoconductors). Nanoconductors can be provided in a variety of shapes and sizes without departing from the teachings herein. A nanoconductor can also be implemented as, for

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example, a molecule or groups of molecules. A nanoconductor can also be implemented as, for example, DNA. Studies have shown that DNA has special electrical properties which can function as essentially a tiny electrical wire. This recent discovery opens up a possible route to new applications in the electronics industry and particularly with respect to the physical neural network disclosed herein. Carbon particles (e.g., granules or bearings) can also be utilized for developing nanoconnections. The nanoconductors utilized to form a connection network can be formed as a plurality of nanoparticles."

Paragraph [0089] also indicates that the term "nanoparticle" can be utilized interchangeably with the term "nanoconductor" and that the term "nanoparticle" can refer simply to a particular type of nanoconductors, such as, for example, a carbon nanoparticle, or another type of nanoconductors, such as, for example, a carbon nanotube or carbon nanowire. In general, paragraph [0089] indicates that devices that conduct electricity and have dimensions on the order of nanometers can be referred to as nanoconductors. A copper ion is not such a device.

It is clear that although nanoconductors come in a variety of shapes and sizes, individual copper ions are NOT such nanoconductors. DNA, for example, is a type of nanoconductor under this definition, as are nanotubes and nanowires and various types of granules or bearings. These are groups of molecules, not copper ions utilized as part of a rather standard electroplating process. Thus, the Examiner is incorrect in asserting that because McHardy discloses copper ions, which have dimensions on the atomic and molecular scale that this reads on the "nanotechnology" of Appellant's invention. Copper ions are not "nanoconductors" as such devices are known in the art (again, see paragraph [0020]) above and therefore, in this sense, McHardy is not "nanotechnology".

McHardy simply does not teach, disclose or suggest such "nanometer-scale" processes, components and or devices. A copper ion is not a nanometer-scale device, but simply just that – an ion – a charged atom. In fact, McHardy actually teaches "micron level" components and components, which are much larger than the nanotechnology components and processes, such as, for example, the nanoconductors and nanoconnections taught by Appellant's invention. McHardy clearly teaches only micro level devices and components and not nanotechnology-based devices and components. For example, Column 7, lines 26-28 of McHardy describes interconnection path lengths that are under 100 microns but preferably

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no more than a few microns. Such dimensions are much larger than the nanometer-scale and hence nanotechnology-based components of Appellant's invention. The "whiskers" taught by McHardy are actually grown at rates of microns per second. For example, Column 7, lines 19-20 of McHardy discusses growth rates of microns per second, which are again not "nanotechnology" (i.e., nanometer scale components) as taught by Appellant's invention. In any event, the micron-level device of McHardy does not disclose or anticipate nanometer-scale components and processes such as that of Appellant's invention.

Although McHardy's Abstract does discuss an input terminal and an output terminal at a distance of less than 100 microns from the input terminal, it is clear from Column 7, lines 19-20 and Column 7, lines 26-28 of McHardy that the whiskers and associated components of McHardy are micron-level devices and not nanometer-scale devices. Thus, McHardy does not provide for any teaching or disclosure of nanoconductors (e.g., carbon nanotubes, nanowires, etc) as taught by Appellant's invention.

The McHardy device requires the formation of metal ions. In this respect, it is absolutely critical to McHardy that one of the electrodes of McHardy be of a type that will permit this process, what McHardy refers to as a "Migratable Metal". The metal atom must attain charge by losing electrons on a moisture film. The charged atom then feels an electrostatic force, which pulls it toward the cathode where it regains its electrons and is deposited on a permanent interconnect. The function of the McHardy device is not defined without the present of charged metal atoms or ions, which are not nanoconductors as such components are known in the art (again, see paragraph [0020] for a description of what constitutes a nanoconductor). A nanoconductor is a physical component, typically man-made, such as a carbon nano-tube or carbon nano-wire. A silicon nano-tube, for example, is another example of a nanoconductor.

The nanoconductors as taught by Appellant's claim 1 and specification are simply not taught by McHardy. Additionally, it is important to note that the Abstract of McHardy, for example, refers to "an input terminal and an output terminal located at a distance of less than 100 microns" but does not describe nanometer scale conductors. There is simply no teaching of "nanometer scale" components or

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devices in the Abstract of McHardy. "Less than 100 microns" of McHardy's Abstract refers to the distance between input and output terminals but again, does not refer to and/or disclose, teach or suggest nanometer-scale neural network connections and nanometer-scale conductors. Additionally, as indicated earlier, Column 7, lines 19-20 and Column 7, lines 26-28 of McHardy disclose micron-level components and growth rates and provide no hint, teaching or disclosure of nanometer-scale components such as the nanoconductors and nanoconnections of Appellant's invention.

The user of copper ions, although on the atomic and molecular scale, are not in this sense "nanotechnology". A single ion is just that – an ion, i.e. a charged atom. Appellant's background section provides a useful description for what constitutes a nanoconductor. For example, paragraph [0020] of Appellant's background section indicates that integrated circuits and electrical components thereof, which can be produced at a molecular and nanometer scale, include devices such as carbon nanotubes and nanowires, which essentially are nanoscale conductors ("nanoconductors"). Paragraph [0020] of Appellant's specification also teaches that nanoconductors are tiny conductive tubes (i.e., hollow) or wires (i.e., solid) with a very small size scale (e.g., 0.7 to 300 nanometers in diameter and up to 1mm in length), and that their structure and fabrication have been widely reported and are well known in the art. Paragraph [0020] additionally indicates that carbon nanotubes, for example, exhibit a unique atomic arrangement, and possess useful physical properties such as one-dimensional electrical behavior, quantum conductance, and ballistic electron transport. Additionally, paragraph [0023] indicates that attempts have been made to construct electronic devices utilizing nano-sized electrical devices and components. Thus, a copper ion is not a nano-sized electrical device and component such as a nanoconductor. Examples of nanoconductors are nanotubes, nanowires, etc, but not a copper ion. This is an important distinction because McHardy does not provide for any teaching of nanoconductors such as carbon nanotubes. Thus, the Examiner is incorrect in asserting that McHardy reads on the nanotechnology of Appellant's invention.

The McHardy reference does not provide for a teaching of nanoconductors such as nanotubes, nanowires, etc. that are suspended and free to move about in a

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dielectric medium. Again, the copper ions are not nanoconductors. Instead, the copper ions of McHardy form a conductive path between McHardy's terminals. However, in such a conductive path, the copper ions are not suspended and free to move about in a dielectric medium. The whiskers of McHardy are also not suspended and free to move about in a dielectric medium. Instead they are permanently located "in place".

The device of McHardy and Appellant's invention are both used in the context of microelectronic networks. This is, however, where the similarity ends. The following discussion is intended to illustrate, in the most direct and simplest way possible, the significant differences between McHardy and the invention disclosed in Appellant's specification and claimed thereof.

The McHardy device is a chemical device whose foundation is the process of electroplating. The McHardy device requires four basic circuit elements to function:

1. DC voltage source
2. Migratable metal
3. Non-Migratable metal
4. Permanent interconnect.

These components can be seen in Figure 1 below:

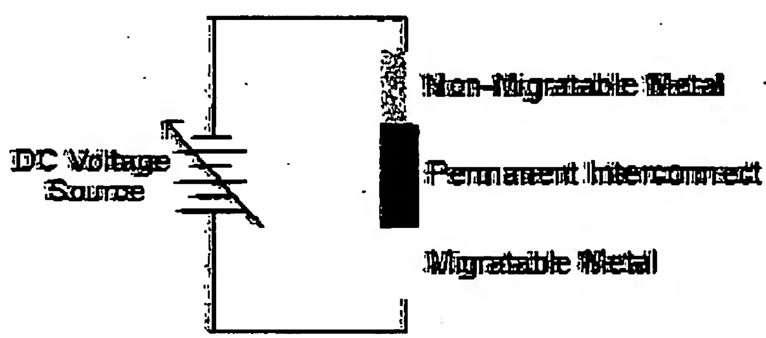

Figure 1

For the McHardy device to function, the materials that compose the McHardy device must display very particular properties which the Appellant will now explain.

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Migratable metal—according to McHardy, many forms of metals can be considered "migratable" including silver, copper, bismuth, cadmium, tin, and lead. In the context of the McHardy synapse, a metal is considered migratable if an ion can be produced in the presence of a moisture film and a voltage source so that the metal ion can move or *migrate* through the moisture film.

Non-Migratable metal—As one might suspect, a non-migratable metal is a metal that does not dissolve in the presence of a moisture film and applied voltage. According to McHardy, non-migratable metals include gold, indium, palladium and platinum.

Permanent Interconnect—According to the McHardy patent, the permanent interconnect can take one of two forms. First, the permanent interconnect may be composed of carbon with an absorbed moisture film on the surface of the carbon interconnect (e.g., see claim 6 of McHardy). Second, it may be composed of mixed halides of rubidium with copper or silver (e.g., see claim 7 of McHardy).

The purpose of the permanent interconnect is to facilitate the conduction of ***ions*** through or across the material, and would not allow for nanoconductors to be suspended and free to move about within the permanent interconnect, unlike Appellant's invention in which Appellant's nanoconductors (e.g., carbon nanotubes, not ions) are suspended and free to move about within Appellant's dielectric medium. As the ions precipitate to atoms ***on or in*** the material, they form conducting filaments that bridge the pre- and post-synaptic (anode and cathode) terminals. This process is directly related to electroplating and this is what forms the permanent interconnect of McHardy. Appellant's invention, on the other hand, constitutes an impermanent interconnect. That is, Appellant's claim 1, for example, discloses nanoconductors that are suspended and <u>free to move about</u> within a dielectric medium, which is why Appellant's resulting connection is impermanent.

The process of metal migration and deposition used in the McHardy synapse is illustrated in Figure 2 below:

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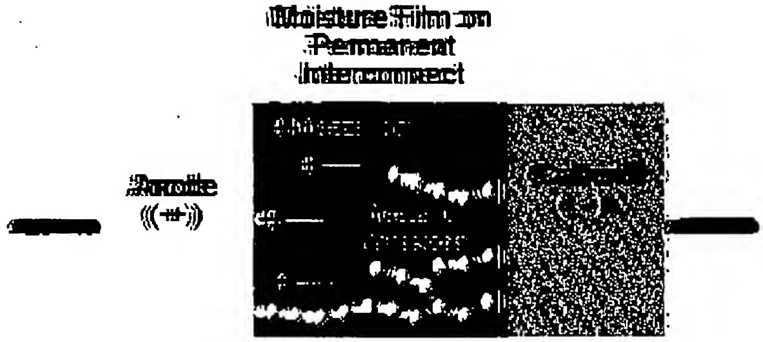

Figure 2

As detailed by McHardy (i.e., see C1, L45-55 of McHardy), metal migration takes place between conductors in an active electronic circuit in the presence of a moisture film. Under the influence of a DC voltage, metal ions dissolve from the positive conductor (the anode). The ions migrate through the moisture film (which is the electrolyte, not a dielectric medium) and plate out on the negative conductor (the cathode). Note that in McHardy, the moisture film does not function as a dielectric medium but as an electrolyte to assist with the metal ions. In McHardy, the deposit often takes the form of metallic whiskers which eventually reach the anode and create an ohmic contact.

Appellant's Invention

Appellant's invention essentially utilizes 4 basic circuit elements to function:

1. Voltage source (AC or DC)
2. Pre-synaptic and post-synaptic electrodes (any conductive substance)
3. Non-electrically conductive viscous solution (e.g, dielectric medium)
4. Electrically conductive (preferably charge-neutral) nanoconductors (e.g., nanotubes, etc., not ions)

An illustrative example of Appellant's invention is shown in Figure 3 below.

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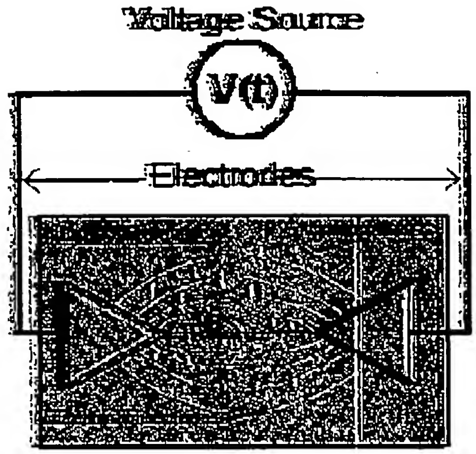

Figure 3

The operation of Appellant's invention is as follows. Pre-synaptic and post-synaptic electrodes (shown as gold/yellow in Figure 3 above) are charged with a voltage source. This voltage may be DC or AC, though AC is preferred. The applied voltage generates an electric field between the electrodes. The region between the electrodes is comprised of a dielectric medium and nanoconductors. The nanoconductors are disposed in and free to move about within the dielectric medium (i.e., dielectric solution). The electric field generates a dipole in the nanoconductors. The dipole induced force, which results from the interaction of the applied electric field with the dipole, draws the nanoconductors into the region between the electrodes. The accumulation of nanoconductors between the electrodes facilitates the electrical conduction between the electrodes.

Device Differences

As stated before, both the device of McHardy and Appellant's invention are intended as a micro-fabricated artificial synapses and that is where the similarity ends. The McHardy device and Appellant's invention, however, operate on completely different physical processes. This fundamental difference is important. We can now compare some of the ways the devices are different so as to aid the Examiner in understanding the underlying physics of the two devices.

Summary of Significant Differences

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1. Use of permanent Interconnect versus non-use
2. Electrochemical versus electromechanical
3. DC voltage versus AC voltage
4. Metal Ions versus conductive nanoconductors
5. Use of Migratable metals versus non-use

Use of permanent interconnect (McHardy) versus non use (Appellant's invention).

As stated previously and illustrated in Figure 1 above and the McHardy Patent, **the McHardy synapse requires a permanent interconnect** between the anode and cathode to facilitate the migration of metal ions from the migratable metal to deposition on the interconnect. The use of this permanent interconnect is fundamental to the operation of the McHardy synapse is explicitly explained throughout the McHardy patent and in all claims.

Appellant's invention requires no permanent interconnect. Instead, as Appellant's invention teaches, nanoconductors suspended and free to move about in the dielectric medium. As Appellant's specification teaches, a dipole-induced force attracts nanoconductors (not limited metal ions) to regions of high energy density, concentrating in the particles in regions where the electric field is highly divergent.

***Electro*chemical *versus Electro*mechanical**

The McHardy synapse utilizes a chemical process to achieve connection variation. The chemical process is fundamental to the operation of the McHardy device and is described in detail throughout the McHardy patent and stated as a limiting aspect of the McHardy invention in every single claim of McHardy. The balancing electrochemical reactions are shown clearly (see for example, C5 L40-65 of McHardy) and make use of the pH changes at the anode and cathode by the electrolysis of water.

By stark contrast, the Appellant's invention is electro*mechanical*. That is, the use of nanoconductors (e.g., nanotubes) disposed and free to move about in a dielectric medium and subject to an electric field is an electromechanical process. No chemical bonds are broken nor made during Appellant's device operation. Appellant's specification indicates that the dipole-induced force of Appellant's

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invention acts to accumulate particles between electrodes to facilitate electrical conduction. Although Appellant's connection could be built with water, the electrolysis that make the McHardy synapse viable could degrade Appellant's synapse by creating hydrogen and oxygen gas. In all likelihood, water will not be used in Appellant's synapse. Substances like ethanol, methanol, and toluene are more likely candidates. Appellant's claimed invention, which is electromechanical nature, stands in contrast to the electrochemical device of McHardy, a much different process.

DC voltage versus AC voltage

The McHardy synapse requires a DC voltage for operation. The electrochemical process can only function in a condition of known DC bias. Indeed, electro migration cannot be defined without reference to a DC bias. Chemical reactions occur on the *anode* and *cathode*. Reversal of the DC bias changes the operational characteristic of the device.

Appellant's synapse, again in stark contracts to the McHardy synapse, is not dependant on voltage polarization. A dipole-induced force is independent of voltage polarization. Appellant's synapse utilizes a voltage bias across a connection to attract nanoconductors to an electrode gap via the dipole-induced force described by Appellant's invention to disperse the nanoconductors.

Metal ions versus conductive nanoconductors

The McHardy synapse requires the formation of metal ions. In this respect, it is absolutely critical that one of the electrodes of McHardy be of a type that will permit this process, what McHardy refers to a "Migratable Metal". The metal atom must attain charge by losing electrons on a moisture film. The charged atom then feels an electrostatic force, which pulls it toward the cathode where it regains its electrons and is deposited on a permanent interconnect. The function of this devise is not defined without the present of charged metal atoms or ions.

In stark contrast to the McHardy synapse, Appellant's synapse does not require metal ions. The principles that render Appellant's synapse operational, (e.g., dipole-induced force) does work on charged particles, but related to the use

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of nanoconductors (conducting electrical components, not ions) such as nanotubes, nanowires, DNA, etc. However, it is advantageous that a particle be charge-neutral so that the only appreciable force felt by the particle is the dielectrophoretic force which will tend to accumulate the particles only between the electrodes rather than the all over the anode or cathode. All of this goes without saying that a nanoconductor, as defined by the Appellant's specification, is NOT the same as a metal ion. Appellant's invention operates with nanoconductors such as DNA or carbon nanotubes, accumulations of elementary material like gold nanoconductors or nanowires, substances such as, for example, latex nano-spheres or complex particles comprising combinations of many types of molecules or atoms, and not simply "ions". The "ions" of McHardy are simply just that...ions...and not nanoconductors as taught by Appellant's invention.

Use of Migratable metals versus non-use

The McHardy synapse requires that a synapse be constructed from two types of metals forming the pre- and post-synaptic electrode terminals. One metal much be a "migratable" metal and the other must be a "non-migratable" metal. McHardy defines a migratable metal as a metal that will form ions in the presence of an electrolyte and an applied voltage. The McHardy synapse is not defined outside of the scope of a device constructed entirely from non-migratable metal. McHardy lists gold as one type of non-migratable metal.

In stark contrast, Appellant's synapse does not require a distinction between migratable and non-migratable metals. Appellant's invention can be constructed entirely on non-migratable metals because its operation is not dependant on metal ions and the effects of electroplating.

Appellant's invention does not require the use of migratable metals as defined by McHardy's electrochemical processes. In fact, McHardy states clearly that gold is a non-migratable metal (i.e., see Col. 3, line 68), whereas with Appellant's invention, gold nanoparticles, for example, can be used in a dielectric solution to form a synapse.

McHardy does not provide any disclosure and anticipation of the dielectric medium and electrically conducting nanoconductors, such as nanotubes, nanowires,

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DNA, etc., that are suspended and free to move about in the dielectric medium. Additionally, it also significant to note that this language of McHardy also refers to the permanent interconnect and an electrolytic path. The Appellant earlier discussed the permanent interconnect and how it is different from Appellant's invention. There is no need to repeat this information, except to note that the use of an electrolytic path implies the use of electrolytic materials rather than dielectric materials. An electrolytic medium is not the same as a dielectric medium. The Examiner asserted that the moisture film will serve as a dielectric medium. Appellant disagrees, the moisture form functions as electrolytic medium. In fact, in col. 5, lines 10-25, McHardy clearly discusses the use of a solid electrolyte.

An electrolytic medium is not a dielectric medium: one exists for the movement of ions to promote electrical conduction (electrolytic); the other is used specifically for its properties of canceling electric fields and inhibiting electrical conduction (dielectric). An electrolytic medium involves the use of an electrolyte and not a dielectric. McHardy provides no teaching, suggestion or disclosure of the use of such a dielectric medium. The "conductors" referred to by McHardy do not constitute a dielectric medium. Again, the moisture film of McHardy does not function as a dielectric medium. McHardy is based on the electrolytic path (i.e., the interconnect 16 of McHardy) and hence an electrolyte, not a dielectric.

An electrolyte is a substance containing free ions which behaves as an electrically conductive medium. A dielectric, on the other hand, is basically an electrical insulator, and constitutes a substance that is highly resistant to electric current. Unlike an electrolyte, a dielectric tends to concentrate an applied electric field within itself. As the dielectric interacts with the applied electric field, charges are redistributed within the atoms or molecules of the dielectric. This redistribution alters the shape of the applied electric field both inside and in the region near the dielectric material. It is this process, when taken with the affects of nanoconductors also displaying a dielectric behavior, which causes a dipole-induced force to attract the nanoconductors to the connection gap.

A dielectric medium is not an electrolytic medium. In fact, the use of an electrolyte teaches away from a dielectric and such materials that concentrate an applied electric field within itself. The electrolytic path of the permanent

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interconnect 16 of McHardy is simply not a dielectric medium as taught by Appellant's invention. The electrolytic path of McHardy extends from the anode to the cathode. In Appellant's invention, on the other hand, there is no such "path" because the nanoconductors are pulled into the electrode gap (i.e., connection gap) from the surrounding dielectric solution and not from the anode.

McHardy also provides no teaching, disclosure or hint of the use of a liquid dielectric medium in the context of actual physical neural networks as taught by Appellant's invention. The Examiner argued that the moisture film is a dielectric medium. However, McHardy provides no teaching of nanoconductors such as nanotubes that are disposed and free to move about within the moisture film. The whiskers for example are not free to move about in McHardy's moisture film. Additionally, the copper ions of McHardy must follow a conductive path and thus are not free to move about within the moisture film either. Additionally, as indicated above and in McHardy's patent, McHardy's device is a permanent interconnect and as such does not allow for nanoconductors such as nanotubes to be "free" to "move about" within McHardy's moisture film. If that were the case, the McHardy device would not function and McHardy's permanent interconnect would fail.

The Appellant refers the Examiner to C 1-6 of McHardy and C1 L44 through C 2 54 regarding the anode and cathode of McHardy. The Appellant notes that there is no electrolytic "path" in Appellant's invention because the nanoconductors are pulled into the electrode gap (i.e., connection gap) from the surrounding dielectric solution and not from the anode. It is significant to note that on C1 L44-45, McHardy states that "...metal migration is an electrochemical process related to electroplating". Appellant's invention does not require nor is based on electroplating as taught by McHardy. Additionally, C 2, lines 4-5 of McHardy refers to the "medium" in which McHardy's whisker growth takes place. This medium of McHardy is not a dielectric liquid solution.

Another significant difference between McHardy and Appellant's invention is that McHardy is a three-terminal device and Appellant's invention is a two-terminal device, which is what is claimed in Appellant's claims. That is, neural connections are formed between pre-synaptic and post-synaptic components of said physical

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neural network, which means that Appellant's invention is two-terminal in nature. On the other hand, the figures of McHardy clearly teach a three-terminal configuration is illustrated. The difference between a three-terminal device and a two-terminal device is significant.

In order to assist the reader(s) of this brief to appreciate this difference, Appellant's provide the following discussion. Imagine two electrical devices – device 1 and device 2. Device 1 is composed of three-terminals, which we will call terminals A, B, C. The conductance between terminal A and C is a function of the voltage of terminal B. In other words, by applying a certain voltage to terminal B, we may increase the conductance between terminals A and C. By applying an opposite voltage, we may weaken the conductance between terminals A and C. Now, picture the second device, device 2, which only has two terminals, which we will refer to as A and C. The conductance between terminals A and C of device 2 is a function of the accumulation of voltage over time between terminals A and C. Now, to make clear how these two devices are used, we can say the following: for device 1, the conductance between terminals A and C is a function of what we do to terminal B; for device 2, the conductance between terminals A and C of device 2 is a function of how we use terminals A and C. Device 2 implies adaptability whereas device 1 implies set-ability.

To put this into a practical perspective, let us assume that device 1 and device 2 occupy equal volumes. Let us further assume that we are trying to build a highly interconnected system on the order of what we see in biological systems (e.g., brains). In this case, we will require on the order of approximately 1 quadrillion (i.e., a million billion) devices, where such devices are equivalent to a synaptic junction. Disregarding the volume taken up by neurons and the wires connecting the synapses, at a bare minimum we know that the volume occupied by these devices would be a 1 quadrillion multiple of the device volume. Now consider device 1. Because of the three terminal nature of device 1, the device cannot be operated as a standalone adaptive element. Rather, we must now create a second circuit such that this circuit takes as an input the voltages on terminals A and C of device 1 and outputs an appropriate voltage onto the terminal B of device 1. The volume of the device 1 implementation is now much greater because it includes not

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only the adaptive element but also the circuit for controlling the adaptive element. So, at a bare minimum, in terms of volume occupied and assuming both devices do indeed occupy the same volume, we can say that the device 2 system implementation occupies at least half the volume of the device 1 system implementation. Now consider that device 1, which is operationally equivalent to the McHardy device has a dimension on the order of 1 cm and that the Appellant's invention has a dimension on the order of, for example, 50 nanometers.

Assuming, for example, that the McHardy device occupies 1 cubic centimeter, then a system with 1 quadrillion of these McHardy elements would occupy roughly 1 cubic kilometer, which to put in perspective is about the size of a small mountain. But this is only for McHardy's device. To take into account the circuitry required to implement adaptability as discussed above, we would need at least twice this volume. Now, consider the Appellant's invention, which is based on nanoscale device dimensions. Assuming, for example, that the Appellant's device is around 100 nanometers by 100 nanometers by 10 nanometers, then the volume occupied by 1 quadrillion of Appellant's two-terminal synapses is 10 cm^3, which is roughly the size of a human brain.

There can be no doubt that the Appellant's use of a two-terminal configuration (which is not taught, disclosed or suggested by McHardy) instead of a three-terminal invention (which is taught by McHardy) is a significant improvement over McHardy and a fundamental nonobvious difference between Appellant's invention and the McHardy device.

The process of assembling a conducting bridge of nanoconductors by inducing a dipole in the nanoconductors (e.g., nanotubes, nanowires, nanoparticles, etc.) as taught by Appellant's invention is a **completely different physical process than that proposed by McHardy**.

The connection described by Appellant's invention works with **charge neutral** particles, a feat absolutely NOT possible with the device of McHardy. That is, the nanoconductors (e.g., nanotubes, nanowires, nanoparticles) are charge neutral, unlike the "ions" of McHardy. Such conductors by their very nature are charge neutral. Ions always exhibit a charge, whether negative or positive. The

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nanoconductors described in Appellant's invention are charge neutral and do not always exhibit a charge as ions do.

As further direct evidence that the device, as described by McHardy, bears no similarity to Appellant's invention, one only need look at the title of the McHardy reference: "**Electrochemical** synapses for artificial neural networks". McHardy is based on electrochemical processes. Appellant's invention, on the other hand, is **electromechanical in nature.** That is, electrochemical processes do not occur with respect to Appellant's neural network device, which instead is based on electromechanical functions (e.g., conductors, dielectric, electrodes, etc).

The device, as described by McHardy, on the other hand, teaches the following electrochemical processes (see McHardy, C1, L46-55 and C3, L8-10):

"Metal migration is an electrochemical process related to electroplating. Metal migration takes place between conductors in an active electronic circuit in the presence of a moisture film. Under the influence of a DC voltage, metal ions dissolve from the positive conductor (the anode). The dissolved ions migrate through the moisture film (the electrolyte) and plate out on the negative conductor (the cathode). The deposit often takes the form of metallic whiskers which eventually reach the anode and create an ohmic contact."

And

"As another feature of the present invention, permanent interconnects are provided which include mixed halides of rubidium with copper or silver."

Appellant's invention does not utilize the metal migration of McHardy, which requires, 1) a DC voltage, 2) metal ions, 3) a permanent connection between pre- and post-synaptic electrode that forms the cathode and 4) a reversed-biased voltage to weaken the connection.

Appellant's invention 1) does NOT require a DC voltage, but will also work with AC; 2) does NOT require metal ions, but rather utilizes charge neutral particles such as nanoconductors (e.g., nanotubes, nanowires, nanoparticles, etc); 3) does NOT require permanent connection between pre- and post-synaptic electrodes, but builds this connection from the charge neutral particles; and 4) does not weaken connections by a reverse bias, but rather random thermal motion.

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Thus, there are in fact significant differences in the physics between Appellant's invention and McHardy's device, in addition to incredible differences in the manner in which the devices are controlled. For example, McHardy does not teach controlling a neural network using the dielectric medium of Appellant's invention, which brings us to Liaw.

There are significant differences between Liaw and Appellant's invention. Liaw details an adaptive information processing system that stems from a model of biological synaptic junction. In essence, earlier neural network models regard a synaptic junction as a static modifiable weighting parameter. Biological synapses are not actually static as a result of the complex molecular interactions that occur within the synaptic junction. Liaw has shown that a more biologically realistic synaptic junction can, in fact, be used to one's advantage to emulate more powerful signal processing systems. Liaw specifically teaches a particular abstract mathematical model for describing a neural network composed of dynamic rather than static synaptic junctions. Liaw claims this model independently from its actual implementation, which Liaw states can take on a variety of forms from digital simulation to analog devices. However, the heart of the Liaw patent only lies in the details of the specific mathematical model that Liaw describes, which is outlined and limited to equations 1-12 of Liaw. This is important, but in essence, Liaw does not relate to an actual physical neural network, but to a mathematical model and hence, an algorithm.

To be fair to the very large field of computational neuroscience, the Liaw patent discloses one (of which there are many) neural models that use dynamically variable synaptic junctions and spike time plasticity. The Appellant's disclosure of using plasticity, including AHAH, focuses on Appellant's synaptic device. Although it would be possible to use the Appellant's synaptic device to implement a neural system composed of dynamically variable synapses and associated learning mechanisms, as described by Liaw in equations 1-12 of Liaw, the Appellant does not claim this. Essentially, the Appellant is patenting a tool that can be used to build any number of dynamic adaptive neural systems. Liaw, on the other hand, is patenting a specific adaptive neural system in the context of a discussion of an abstract <u>concept</u>, whereas Appellant's invention claims a specific <u>device</u> or

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implementation. This is a fundamental but important difference between Liaw and Appellant's invention.

Despite these broad differences, it is important to realize that Liaw provides no disclosure, teaching and/or suggestion of the fundamental building blocks of Appellant's invention. These include the use of a dielectric medium and nanoconductors as taught by Appellant's invention in the context of an actual physical neural network. Additionally, there is no teaching, suggestion or hint of the use of nanoconductors (e.g., carbon nanoconductors, nanotubes, etc) in Liaw as taught by Appellant's invention or any physical implementation. In fact, there is not even a mention of nanotechnology by Liaw. One skilled in the art would not look to Liaw as a basis for forming a nanotechnology-based neural networks as disclosed by Appellant.

Liaw in no way shape or form shows how a physical neural network can be built, and in particular how this could be accomplished using a dielectric medium, nanoconductors, etc. In this sense, the Examiner's analysis for combining Liaw with McHardy was not made explicit. Given that McHardy does not provide for a teaching of nanotechnology and for nanoconductors such as carbon nanotubes, nanowires, etc., and that Liaw also does not teach nanotechnology and nanoconductors, a dielectric medium, etc, it is not clear how one could expect a reasonable expectation of success for such the combination of Liaw/McHardy given this lack of a thorough and essential teaching of key aspects of Appellant's claimed invention. Which components of Liaw would actually be connected to which specific components of McHardy and in what particular manner in order to provide for the teaching or suggestion of all the claim limitations of Appellant's invention? The Examiner has mere stated that "it would have been obvious" to combine the teachings of McHardy with that of Liaw in order to govern how the neural network adapts, but has not indicated how this would actually be done, given the lack of the essential teaching of nanotechnology by both McHardy and Liaw.

It is also significant to note that Liaw at col. 1, lines 9-10 states that the "present invention relates...to neural network models that simulate and extend biological neural networks". Appellant's invention is not simulating or extending biological neural networks. Rather, Appellant's device IS a physical neural network.

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It is important to understand the difference between a simulation of a system and an actual implementation of the system in the context of the Liaw reference and Appellant's invention.

Regarding claim 9 and the argument by the Examiner that McHardy teaches nanowires via McHardy's whiskers, the Appellant notes all of the arguments provided above by Appellant above apply equally against the rejection to claim 9. Additionally, the Examiner has made an argument previously that the "copper ions" of McHardy are the same as Appellant's nanoconductors, but now argues that the whiskers of McHardy are the same as nanoconductors. Which is it? It cannot both. Appellant's claimed invention has a specific requirement that that Appellant's nanoconductors be suspended and free to move about in Appellant's dielectric medium to form neural connections. Are McHardy's whiskers be suspended and free to move about in Appellant's dielectric medium to form neural connections or are McHardy's "copper ions" free to move about in Appellant's dielectric medium to form neural connections? Thus, the additional argument by the Examiner with respect to claim 9 appears to contradict the original argument by the Examiner with respect to claim 1 and is therefore improper. It does not appear from McHardy that the "whiskers" of McHardy are suspended and free to move about in a dielectric medium. Similarly, regarding claim 10 and the argument by the Examiner that "ion insertion compounds" of McHardy constitute nanoparticles, the Examiner has now introduced a third and different feature, which is different from the copper ions and whiskers of McHardy. So, are all of McHardy's copper ions, whiskers and copper insertion compounds suspended and free to move about in Appellant's dielectric medium to form neural connections? It does not appear that this is possible and that the Examiner's arguments with respect to claims 1, 9 and 10 are not consistent and therefore are improper and should be withdrawn, particularly because the analysis thereof has not been made explicit.

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APPELLANT'S ARGUMENTS REGARDING ISSUE #3 - ARGUMENTS IN SUPPORT OF PATENTABILITY OF CLAIMS 2-7

Claims 2-7 are patentable over McHardy in view of Liaw, and further in view of Nervegna.

Regarding claims 2-7, the Examiner admitted that McHardy in combination with Liaw do not explicitly teach utilizing voltage gradient, voltage gradient dependencies, pre-synaptic and post-synaptic frequencies to implement Hebbian plasticity and anti-Hebbian plasticity.

The Examiner argued, however, that Nervegna teaches Hebbian synapse circuit that utilizes voltage gradient, voltage gradient dependencies, pre-synaptic and post-synaptic frequencies to implement Hebbian plasticity and anti-Hebbian plasticity. In support of this argument, the Examiner cited Nervegna, Abstract, Col. 2, lines 45-64; Col. 3, lines 59-67; Col. 4, lines 1-17, lines 23-67; Col. 5, lines 1-31; FIG. 15, 15A, 15B; and Col. 20, lines 7-15).

The Examiner asserted that it would have been obvious at the time the invention was made to one of ordinary skill in the art to combine the teachings of McHardy in combination with Liaw with the Hebbian synapse circuit as taught by Nervegna for the purpose of providing neural computation in a manner which is more realistic.

The Appellant disagrees with this assessment and notes that arguments presented above against the rejection to claims 1, 9, and 10 apply equally against the rejection of claims 2-7 as being unpatentable over McHardy, Liaw and Nervegna. In the interest of brevity, these arguments will not be repeated.

Appellant notes, however, that Nervegna provides for absolutely no teaching of nanotechnology and is a much larger device, based on CMOS and VLSI principals. For example, Col. 2, lines 15-30 discusses CMOS and VLSI devices. Col, 8, lines 35-52 of Nervegna also teaches the use of CMOS technology, and not nanotechnology. There is no hint, teaching or suggestion of nanotechnology and nanoconductors such as carbon nanotubes, nanowires, DNA, etc. in the Nervegna reference. Simply because Nervegna discusses Hebbian learning in general does not support the proposition that one skilled in the art could readily modify Nervegna

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with McHardy and Liaw, particularly in light of the arguments set forth earlier herein against the rejection to claims 1, 9 and 10. Nervegna also requires the use of an ion-channel circuit, which is a very large device that again, is non-nanotechnological in nature. That is, the components utilized to construct the Nervegna device are much larger than that of Nervegna. FIGS. 1-17 of Nervegna clearly show a variety of transistors, resistors and so forth, which are not nanotechnology-based but are much larger CMOS type devices and components. Thus, it is improper to allege that Nervegna could some be easily modified to produce a nanotechnological device such as that of Appellant's invention given the lack of teaching of nanotechnology by Nervegna.

Additionally, there is not a teaching in Nervegna of <u>anti-Hebbian</u> plasticity. The Examiner has cited Nervegna, the Abstract, Col. 2, lines 45-64; Col. 3, lines 59-67; Col. 4, lines 1-17, lines 23-67; Col. 5, lines 1-31; FIG. 15, 15A, 15B; and Col. 20, lines 7-15, but none of these cited sections of the Nervegna provide any teaching of anti-Hebbian plasticity. Also, it is not clear where Nervegna teaches the use of pre-synaptic and post-synaptic frequencies. Where are such frequencies specifically taught by Nervegna? The Examiner has cited the Abstract, Col. 2, lines 45-64; Col. 3, lines 59-67; Col. 4, lines 1-17, lines 23-67; Col. 5, lines 1-31; FIG. 15, 15A, 15B; and Col. 20, lines 7-15, but again has not pointed out specifically where and how such pre-synaptic and post-synaptic frequencies are taught by Nervegna. The Examiner has also not explained how Nervegna teaches a learning mechanism that utilizes a voltage gradient to implement Hebbian plasticity within said physical neural network or how Nervegna utilizes voltage gradient dependencies associated with a physical neural network to implement Hebbian learning within the physical neural network. Further, how would Nervegna physically be modified by Liaw and McHardy to achieve this in the context of a physical an impermanent physical neural network such as Appellant's invention.

Additionally, Nervegna is essentially an electrical device with electrical components such as transistors, etc. It is not clear how the electrical device of Nervegna would function with the electrochemical device of McHardy. The moisture film of McHardy alone would likely cause the Nervegna components to short and "fry" the Nervegna components.

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Based on the foregoing, the Appellant submits that the rejection to claims 1, 9, and 10 has been traversed. Appellant respectfully requests allowance of claims 1, 9, and 10.

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APPELLANT'S ARGUMENTS REGARDING ISSUE #4 - ARGUMENTS IN SUPPORT OF PATENTABILITY OF CLAIM 8

Claim 8 is patentable over McHardy in view of Liaw, and further in view of Brandes.

Regarding claim 8, the Examiner admitted that McHardy in combination with Liaw do not explicitly teach nanoconductors that comprise nanotubes. The Examiner argued, however, that Brandes teaches nanoconductors comprising nanotubes and cited Brandes, the Abstract, Col. 1, lines 55-62; Col. 2, lines 31-37; and Col. 4, lines 27-58 and argued that it would have been obvious at the time the invention was made to one of ordinary skill in the art to combine the teachings of McHardy in combination with Liaw with the nanoconductors comprising carbon nanotubes as taught by Brandes for the purpose of capitalizing on the semiconducting properties of carbon nanotubes.

The Appellant disagrees with this assessment and notes that arguments presented above against the rejection to claims 1, 9, and 10 apply equally against the rejection to claim 8 as being unpatentable over McHardy, Liaw and Brandes. In the interest of brevity, these arguments will not be repeated.

The Appellant further notes that Brandes does not provide for any teaching of neural networks and in particular Hebbian learning. For McHardy to be combined with Liaw and Brandes, there should at least be some teaching in Brandes of neural network components. In fact, the Appellant submits that in order to maintain a rejection under 35 U.S.C. 103 based on McHardy, Liaw and Brandes, all three references should at a minimum provide for a teaching of neural networks and in particular, physical neural networks. It is not clear how would skilled in the art would look to Brandes when Brandes provides no teaching whatsoever of neural network principals and components.

Additionally, the Examiner had previously argued that the copper ions of McHardy are the nanoconductors. Now, the Examiner is arguing that carbon nanotubes of Brandes are the nanoconductors. Would the carbon nanotubes of

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Brandes replace the copper ions of McHardy? How would this be achieved given that a copper ion is much smaller than a carbon nanotube of Brandes? This does not seem physically possible. One skilled in the art would not look to Brandes to replace the copper ions of McHardy with the carbon nanotubes of Brandes. Additionally, the moisture film of McHardy would damage the carbon nanotubes of Brandes and the carbon nanotubes of Brandes would not function in association with the conductive path of McHardy, because again, as explained previously, McHardy is an electrochemical device and Brandes is electromechanical. The two devices could not function together as alleged by the Examiner. In fact, Brandes specifically teaches a micro-electromechanical and hence, an electromechanical device. See, for example, the Abstract of Brandes and Col. 1, lines 55-62; Col. 2, lines 31-37; and Col. 4, lines 27-58 of Brandes, which all relate to electromechanical principals and components.

McHardy, again, is electrochemical in nature (this has all been explained earlier with respect to the arguments by the Appellant against the rejection to claims 1, 9, 10), which represents a much different device than the nanotechnology-based Hebbian and ant-Hebbian plasticity device of Appellant's invention. In fact, the electrochemical components of McHardy would actually damage Appellant's invention, and in particular, appellant's nanoconductors, which would not function in the moisture film of McHardy in the context of a neural network. Additionally, the electroplating process of McHardy in association with the moisture film of McHardy would render the carbon nanotubes of Brandes useless. They simply would not work with McHardy. That is, the carbon nanotubes of Brandes would not function with the electrochemical components of McHardy. Thus, one skilled in the art would not be inclined to combine Brandes with McHardy, let alone Llaw as argued by the Examiner.

Based on the foregoing, the Appellant submits that the rejection to claim 8 has been traversed. Appellant respectfully requests allowance of claim 8.

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APPELLANT'S ARGUMENTS REGARDING ISSUE #5 - ARGUMENTS IN SUPPORT OF PATENTABILITY OF CLAIM 11

Claim 11 is patentable over McHardy in view of Liaw, and further in view of Nervegna.

Regarding claim 11, the Examiner argued that McHardy teaches a system, comprising:

a physical neural network configured utilizing nanotechnology (*the Examiner cited McHardy, Abstract, lines 1-4; Col. 1, lines 8-12, lines 46-55; Col. 4, lines 8-20, and argued that McHardy discloses copper ions, which have dimensions on the atomic and molecular scale and asserted that it reads on nanotechnology of Appellant*), wherein said physical neural network comprises a plurality of nanoconductors suspended and free to move about in a dielectric medium and which form neural connections between pre-synaptic and post-synaptic components of said physical neural network (*the Examiner cited the Abstract, Col. 1, lines 29-55; Col. 2, lines 45-54; Col. 3, lines 44-62; Col. 4, lines 8-45; and FIGS. 1-3, and argued that the dissolved copper ions will form a conductive path between the terminals creating the connections of the neural network. The Examiner further argued that the moisture film will serve as a dielectric, arguing that is serves as an insulating medium intervening between the two conductors, arguing the input and output of the synapse; the Examiner further argued that that the carbon channel or carbon deposited layer that contains the moisture film is also a dielectric; the Examiner also argued that the precipitation of copper ions will grow copper whiskers (arguing "nanoconductors") which will be disposed in the dielectric medium (but Appellant notes that the whiskers are not free to move about within the dielectric medium); the Examiner further argued that pre-synaptic components are the input terminals and post-synaptic components are the output terminals*); and

The Examiner admitted that McHardy does not teach a learning mechanism for applying Hebbian learning to the physical neural network.

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The Examiner argued that Liaw teaches a learning mechanism for applying Hebbian learning to a physical neural network (the Examiner cited Liaw, Col. 13, lines 5-18).

The Examiner therefore asserted that it would have been obvious at the time the invention was made to one of ordinary skill in the art to combine the teachings of McHardy with the learning mechanism for applying Hebbian learning as taught by Liaw for the purpose of having means to govern how the neural network is to adapt its connections to produce a correct input-output mapping.

The Examiner admitted that McHardy in combination with Liaw do not explicitly teach utilizing voltage gradient, voltage gradient dependencies, pre-synaptic and post-synaptic frequencies to implement Hebbian plasticity and anti-Hebbian plasticity.

The Examiner argued that Nervegna teaches Hebbian synapse circuit that utilizes voltage gradient, voltage gradient dependencies, pre-synaptic and post-synaptic frequencies to implement Hebbian plasticity and anti-Hebbian plasticity (the Examiner cited Nervegna, Abstract; Col. 2, lines 45-64; Col. 3, lines 59-67; Col. 4, lines 1-17, lines 23-67; Col. 5, lines 1-31; FIG. 15, 15A, 15B; and Col. 2, lines 7-15).

The Examiner therefore asserted that it would have been obvious at the time the invention was made to one of ordinary skill in the art to combine the teachings of McHardy in combination with Liaw with the Hebbian synapse circuit as taught by Nervegna for the purpose of providing neural computation in a manner which is more realistic.

The Appellant disagrees with this assessment and notes that arguments presented above against the rejection to claims 1, 9, and 10 apply equally against the rejection to claim 11 as being unpatentable over McHardy, Liaw and Nervegna. In the interest of brevity, these arguments will not be repeated. The Appellant further notes that the arguments presented above against the rejection to claims 2-7 apply equally against the rejection to claim 11.

Nervegna provides for absolutely no teaching of nanotechnology and is a much larger device, based on CMOS and VLSI principals. For example, Col. 2, lines 15-30 discusses CMOS and VLSI devices. Col, 8, lines 35-52 of Nervegna also

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teaches the use of CMOS technology, and not nanotechnology. There is no hint, teaching or suggestion of nanotechnology and nanoconductors such as carbon nanotubes, nanowires, DNA, etc. in the Nervegna reference. Simply because Nervegna discusses Hebbian learning in general does not support the proposition that one skilled in the art could readily modify Nervegna with McHardy and Liaw, particularly in light of the arguments set forth earlier herein against the rejection to claims 1, 9 and 10. Nervegna also requires the use of an ion-channel circuit, which is a very large device, which again, is non-nanotechnological in nature. That is, the components utilized to construct the Nervegna device are much larger than that of Nervegna. FIGS. 1-17 of Nervegna clearly show a variety of transistors, resistors and so forth, which are not nanotechnology-based but are much larger CMOS type devices and components. Thus, it is improper to allege that Nervegna could some be easily modified to produce a nanotechnological device such as that of Appellant's invention given the lack of teaching of nanotechnology by Nervegna.

Additionally, there is not a teaching in Nervegna of <u>anti-Hebbian</u> plasticity. The Examiner has cited Nervegna, the Abstract, Col. 2, lines 45-64; Col. 3, lines 59-67; Col. 4, lines 1-17, lines 23-67; Col. 5, lines 1-31; FIG. 15, 15A, 15B; and Col. 20, lines 7-15, but none of these cited sections of the Nervegna provide any teaching of anti-Hebbian plasticity. Also, it is not clear where Nervegna teaches the use of pre-synaptic and post-synaptic frequencies. Where are such frequencies specifically taught by Nervegna? The Examiner has cited the Abstract, Col. 2, lines 45-64; Col. 3, lines 59-67; Col. 4, lines 1-17, lines 23-67; Col. 5, lines 1-31; FIG. 15, 15A, 15B; and Col. 20, lines 7-15, but again has not pointed out specifically where and how such pre-synaptic and post-synaptic frequencies are taught by Nervegna. The Examiner has also not explained how Nervegna teaches a learning mechanism that utilizes a voltage gradient to implement Hebbian plasticity within said physical neural network or how Nervegna utilizes voltage gradient dependencies associated with a physical neural network to implement Hebbian learning within the physical neural network. Further, how would Nervegna physically be modified by Liaw and McHardy to achieve this in the context of a physical an impermanent physical neural network such as Appellant's invention.

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Additionally, Nervegna is essentially an electrical device with electrical components such as transistors, etc. It is not clear how the electrical device of Nervegna would function with the electrochemical device of McHardy. The moisture film of McHardy alone would likely cause the Nervegna components to short and "fry" the Nervegna components.

Based on the foregoing, the Appellant submits that the rejection to claim 11 has been traversed. Appellant respectfully requests allowance claim 11.

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APPELLANT'S ARGUMENTS REGARDING ISSUE #6 - ARGUMENTS IN SUPPORT OF PATENTABILITY OF CLAIMS 13, 14, 15, 16

Claims 13, 14, 15, 16 are patentable over McHardy in view of Liaw, and further in view of Nervegna.

Regarding claim 13, the Examiner argued that McHardy in combination with Liaw and Nervegna teach the system of claim 11 wherein said plurality of nanoconductors includes nanoconductors comprising nanowires. In support of this argument, the Examiner cited McHardy, Col. 1, lines 46-55; Col. 4, lines 8-30; Col. 7, lines 10-14 and asserted that the metallic whiskers are nanowires).

Regarding claim 14, the Examiner argued that McHardy in combination with Liaw and Nervegna teach the system of claim 11 wherein said plurality of nanoconductors include nanoconductors comprising nanoparticles. In support of this argument, the Examiner cited McHardy, Col. 5, lines 10-40 and asserted that ion insertion compounds are nanoparticles.

Regarding claim 15, the Examiner argued that McHardy in combination with Liaw and Nervegna teach the system of claim 11 wherein said dielectric medium comprises a dielectric liquid. In support of this argument, the Examiner cited McHardy, Col. 1, lines 46-55; Col. 4, lines 8-20 and asserted that the moisture film reads on the dielectric liquid. If this is the case, are the ion insertion compounds, the metallic whiskers and/or the copper ions, which the Examiner alleges are nanoconductors, disposed and free to move about within the moisture compound to form a neural connection?

The Appellant disagrees with this assessment and notes that arguments presented above against the rejection to claims 1, 9, and 10 apply equally against the rejection to claims 13, 14, 15, 16 as being unpatentable over McHardy, Liaw and Nervegna. In the interest of brevity, these arguments will not be repeated.

The Appellant further notes that the arguments presented above against the rejection to claims 2-7 apply equally against the rejection to claim 11.

Nervegna provides for absolutely no teaching of nanotechnology and is a much larger device, based on CMOS and VLSI principals. For example, Col. 2, lines 15-30 discusses CMOS and VLSI devices. Col, 8, lines 35-52 of Nervegna also

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teaches the use of CMOS technology, and not nanotechnology. There is no hint, teaching or suggestion of nanotechnology and nanoconductors such as carbon nanotubes, nanowires, DNA, etc. in the Nervegna reference. Simply because Nervegna discusses Hebbian learning in general does not support the proposition that one skilled in the art could readily modify Nervegna with McHardy and Liaw, particularly in light of the arguments set forth earlier herein against the rejection to claims 1, 9 and 10. Nervegna also requires the use of an ion-channel circuit, which is a very large device, which again, is non-nanotechnological in nature. That is, the components utilized to construct the Nervegna device are much larger than that of Nervegna. FIGS. 1-17 of Nervegna clearly show a variety of transistors, resistors and so forth, which are not nanotechnology-based but are much larger CMOS type devices and components. Thus, it is improper to allege that Nervegna could some be easily modified to produce a nanotechnological device such as that of Appellant's invention given the lack of teaching of nanotechnology by Nervegna..

Additionally, there is not a teaching in Nervegna of anti-Hebbian plasticity. The Examiner has cited Nervegna, the Abstract, Col. 2, lines 45-64; Col. 3, lines 59-67; Col. 4, lines 1-17, lines 23-67; Col. 5, lines 1-31; FIG. 15, 15A, 15B; and Col. 20, lines 7-15, but none of these cited sections of the Nervegna provide any teaching of anti-Hebbian plasticity. Also, it is not clear where Nervegna teaches the use of pre-synaptic and post-synaptic frequencies. Where are such frequencies specifically taught by Nervegna? The Examiner has cited the Abstract, Col. 2, lines 45-64; Col. 3, lines 59-67; Col. 4, lines 1-17, lines 23-67; Col. 5, lines 1-31; FIG. 15, 15A, 15B; and Col. 20, lines 7-15, but again has not pointed out specifically where and how such pre-synaptic and post-synaptic frequencies are taught by Nervegna. The Examiner has also not explained how Nervegna teaches a learning mechanism that utilizes a voltage gradient to implement Hebbian plasticity within said physical neural network or how Nervegna utilizes voltage gradient dependencies associated with a physical neural network to implement Hebbian learning within the physical neural network. Further, how would Nervegna physically be modified by Liaw and McHardy to achieve this in the context of a physical an impermanent physical neural network such as Appellant's invention.

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Additionally, Nervegna is essentially an electrical device with electrical components such as transistors, etc. It is not clear how the electrical device of Nervegna would function with the electrochemical device of McHardy. The moisture film of McHardy alone would likely cause the Nervegna components to short and "fry" the Nervegna components.

One skilled in the art would not consider combining Nervegna with McHardy for the simple reason that the McHardy's electrochemical process involves the release of acids and bases, which would damage the electrical components of Nervegna. For example, Co. 4, lines 30-40 of McHardy indicates the presence of hydrogen ions (acid). This alone would damage the electrical components of Nervegna, so it would not make sense for one skilled in the art to even consider combining Nervegna with McHardy.

Regarding the Examiner's assertion that the metallic whiskers of McHardy are nanowires, the Examiner is again contradicting the earlier argument that the copper ions are the nanoconductors. Additionally, as indicated earlier, Appellant's invention requires that Appellant's nanoconductors be disposed and <u>free to move</u> about within the dielectric medium. Due to the electroplating (electrochemical) process of McHardy, the whiskers of McHardy are not free to move about in a dielectric medium but are grown along a specific electrochemical conductive path. According to Col. 1, lines 46-55 of McHardy, the whiskers are grown along a deposit due to metal migration. This is not the same as nanoconductors disposed and free to move about within a dielectric medium.

Regarding the assertion that ion insertion compounds are nanoparticles, this again contradicts the Examiner's earlier allegation that the copper ions of McHardy are the nanoconductors. The Examiner is arguing then that the copper ions and the ion insertion compounds are the same thing, the same nanoconductors? McHardy indicates that they are not. The ion insertion compounds discussed at Col. 5, lines 10-40 are also not disposed and free to move about within a dielectric medium.

Regarding the assertion that the moisture film of McHardy reads on the dielectric liquid, this is also not the case because in Appellant's claimed inventions, Appellant's nanoconductors are disposed and free to move about within the dielectric liquid. The release and presence of acid on the part of the electroplating

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process of McHardy in combination with McHardy's moisture film would simply damage Appellant's nanoconductors. Thus, while McHardy's whiskers would function in association with McHardy's moisture film, the mere presence of such acids and bases would damage Appellant's nanoconductors and upset the function of Appellant's dielectric medium.

It is important to appreciate that while a moisture film may function as a dielectric in some scenarios, McHardy does NOT employ McHardy's moisture film as a dielectric liquid in which nanoconductors (e.g., nanotubes, nanowires, DNA, etc.) are disposed and free to move about. McHardy's moisture film does not function as a dielectric; it only permits metal migration, that is, the growth of a metal conductor from one contact to another. Appellant's invention does not involve the growth of metal whiskers between whiskers. Instead, in Appellant's claimed invention, the nanoconductors are actually disposed and free to move about within the dielectric medium and not "grown" between terminals.

Regarding the Examiner's argument that applying a voltage across the anode and cathode will create an electric field and that electric field exists where there is current density, the Appellant's submits that is irrelevant because the electrical components of Nervegna would not function in the electroplating process of McHardy. The Nervegna device would be damaged by the electrochemical process of McHardy. The release of acids and bases by McHardy would damage the electrical components of Nervegna.

Based on the foregoing, the Appellant submits that the rejection to claims 13, 14, 15, 16 has been traversed. Appellant respectfully requests allowance of claims 13, 14, 15, 16.

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APPELLANT'S ARGUMENTS REGARDING ISSUE #7 - ARGUMENTS IN SUPPORT OF PATENTABILITY OF CLAIM 12

Claim 12 is patentable over McHardy in view of Liaw, and further in view of Nervegna and Brandes.

Regarding claim 12, the Examiner admitted that McHardy in combination with Liaw and Nervegna do not explicitly teach nanoconductors that include nanoconductors comprising nanotubes.

The Examiner argued, however, that Brandes teaches nanoconductors comprising nanotubes. The Examiner cited Brandes, Abstract, Col. 1, lines 55-62; Col. 2, lines 31-37; and Col. 4, lines 27-58 in support of this argument.

The Examiner asserted that it would have been obvious at the time the invention was made to one of ordinary skill in the art to combine the teachings of McHardy in combination with Liaw and Nervegna with the nanoconductors comprising carbon nanotubes as taught by Brandes for the purpose of capitalizing on the semiconducting properties of carbon nanotubes.

The Appellant disagrees with this assessment and notes that arguments presented above against the rejection to claims 1, 9, and 10 apply equally against the rejection to claim 12 as being unpatentable over McHardy, Liaw and Nervegna and Brandes. In the interest of brevity, these arguments will not be repeated. The Appellant further notes that the arguments presented above against the rejection to claims 2-7 also apply against the present rejection to claim 12. Additionally, the Appellant notes that the arguments presented above against the rejection to claim 8 also apply against the present rejection to claim 12.

The nanotubes of Brandes could not be combined with McHardy because the electroplating process of McHardy (e.g., released acids) would damage the nanotubes of Brandes. Also, by asserting that the nanotubes of Brandes could somehow replace the individual copper ions (which the Examiner had earlier asserted are nanoconductors), the Examiner is presenting a scenario that would be impossible. Individual copper ions are too small for replacement by the much larger nanotubes of Brandes. Additionally, Brandes provides no teaching whatsoever of neural network or neural network components. Thus, it would not make sense for

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one skilled in the art to look to Brandes and McHardy for a combination thereof. Additionally, the Hebbian circuit components of Liaw would also be damaged by the electrochemical /electroplating process of McHardy. Again, one skilled in the art would not be included to combine Liaw with McHardy due to the presence of potentially damaging acids of McHardy.

Based on the foregoing, the Appellant submits that the rejection to claim 12 has been traversed. Appellant respectfully requests allowance of claim 12.

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APPELLANT'S ARGUMENTS REGARDING ISSUE #8 - ARGUMENTS IN SUPPORT OF PATENTABILITY OF CLAIMS 17, 18 and 20.

Claims 17-18 and 20 are not anticipated by McHardy.

Regarding claim 17, the Examiner argued that McHardy teaches a system, comprising:

a plurality of molecular conductors disposed in and free to move about within a dielectric medium comprising a dielectric solvent or a dielectric solution (the Examiner cited McHardy the Abstract, Col. 1, lines 29-55; Col. 2, lines 45-54; Col. 3, lines 44-62; Col. 4, lines 8-45; and FIGS. 1-3; the Examiner argued that the dissolved copper ions will form a conductive path between the terminals creating the connections of the neural network and that the moisture film will serve as a dielectric, arguing that it serves as an insulating medium intervening between two conductors, asserting the input and output of the synapse; the Examiner further argued that the carbon channel or carbon deposited layer that contains the moisture film is also a dielectric solvent (*the Appellant asks: are nanoconductors disposed and free to move about in a dielectric solutions based on this so-called dielectric solvent); the Examiner argued that the precipitation of copper ions will grow copper whiskers (arguing molecular conductors) which will be disposed in the dielectric medium (again, Appellant asks, are such whiskers <u>free to move about</u> in the dielectric medium? The answer is clearly <u>no</u>; also, the Appellant asks what is that that the Examiner asserts constitutes nanoconductors, the whiskers or the copper ions? The copper ions are also not free to move about in the conductive path of McHardy because they must follow this conductive path. Additionally, the copper ions and not disposed and free to move about in the moisture film, which the Examiner alleges constitutes a dielectric medium; Additionally, McHardy teaches a permanent interconnect, thus in such a permanent configuration, nanoconductors are not free to move about, i.e., because it is permanent*);

at least one input electrode in contact with said dielectric medium (the Examiner cited McHardy, the Abstract, and asserted that input terminals read on input electrode); and

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at least one output electrode in contact with said dielectric medium, wherein said plurality of molecular conductors form physical neural connections when said dielectric medium is exposed an electric field across said at least one input electrode and said at least one output electrode, such that said physical neural connections can be strengthened or weakened depending upon a strengthening or weakening of said electric field or an alteration of a frequency thereof (the Examiner cited McHardy, Col. 1, lines 46-55; Col. 4, lines 21-45; Col. 7, lines 6-18, and asserted that applying a voltage across the anode and cathode will create an electric field and that an electric field exists where there is a current density).

Regarding claim 18, the Examiner argued that McHardy teaches the system of claim 17 further comprising a physical neural network comprising said plurality of molecular conductors disposed within a dielectric medium comprising a dielectric solvent or a dielectric solution, said at least one input electrode in contact with said dielectric medium, and said at least one output electrode in contact with said dielectric medium. In support of this argument, the Examiner cited McHardy, the Abstract, Col. 1, lines 29-55; Col. 2, lines 45-54; Col. 3, lines 44-62; Col. 4, lines 8-45; and FIGS. 1-3, and argued that the dissolved copper ions will form a conductive path between the terminals creating the connections of the neural network. The Examiner further asserted that the moisture film will serve as a dielectric, since it serves as an insulating medium intervening between two conductors, arguing the input and output of the synapse. The Examiner further argued that the carbon channel or carbon deposited layer that contains the moisture film is also a dielectric solvent. The Examiner further argued that the precipitation of copper ions will grow copper whiskers (arguing "molecular conductors") which will be deposited in the dielectric medium. Appellant notes that such copper whiskers are not free to move about within a dielectric medium.

Regarding claim 20, the Examiner argued that McHardy teaches the system of claim 18 wherein said physical neural network is configured as an integrated circuit chip utilizing nanotechnology and cited FIG. 1 of McHardy in support of this argument.

The Appellant disagrees with this assessment and notes that arguments presented above against the rejection to claims 1, 9, and 10 under 35 U.S.C. 103

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apply equally against the rejection to claims 17-18, 20 under 35 U.S.C. 102 as being unpatentable over McHardy. In the interest of brevity, these arguments will not be repeated.

According to M.P.E.P. § 2131:

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference". *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 U.S.P.Q. 2d 1051, 1053 (Fed. Cir. 1987). . . . "The identical invention must be shown in as complete detail as is contained in the . . . claim." *Richardsons v. Suzuki Motor Co.*, 868, F.2d 1226, 1236, 9 U.S.P.Q. 2d 1913, 1920 (Fed. Cir. 1989)

Thus, in order to anticipate claims 17-18 and 20, McHardy needs to describe each and every element of the claims and show the claimed invention in complete detail as is contained in the claim.

Claims 17-18 and 20 are provided below, for the reader's convenience, with added emphasis:

17. A system, comprising:

a plurality of molecular conductors disposed in and **free to move** about within a dielectric medium comprising a **dielectric solvent** or a **dielectric solution**;

at least one input electrode in contact with said dielectric medium; and

at least one output electrode in contact with said dielectric medium, wherein said plurality of molecular conductors form physical neural connections **when** said dielectric medium is **exposed** an electric field across said at least one input electrode and said at least one output electrode, such that said physical neural connections can be **strengthened or weakened** depending upon a **strengthening** or **weakening** of said electric field or an alteration of a **frequency** thereof.

18. The system of claim 17 further comprising a physical neural network comprising said plurality of molecular conductors disposed within a dielectric medium comprising a dielectric solvent or a dielectric solution, said at least one input electrode in contact with said dielectric medium, and said at least one output electrode in contact with said dielectric medium.

20. The system of claim 18 wherein said physical neural network is configured as an integrated circuit **chip** utilizing **nanotechnology**.

McHardy involves the use of an electrochemical device in which copper ions grow copper whiskers. The Examiner argued that the copper whiskers are the molecular conductors. This seems to contradict the Examiner's previous arguments

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that the copper ions were the nanoconductors. In any event, the copper whiskers of McHardy, are not free to move about within a dielectric medium, and certainly are not free to move about within the moisture film of McHardy. Instead, the copper whiskers of McHardy are grown along the conductive path of McHardy to create a permanent connection, rather than one that is impermanent (i.e., in which conductors are free to move about). The discussion of McHardy's permanent structure was discussed previously. Col. 4, lines 45-50 of McHardy specifically indicates that the copper oxide whiskers of McHardy are grown along pre-existing paths. The use of such pre-existing paths thus prevent the copper oxide whiskers of McHardy from being disposed in and free to move about within a dielectric medium.

Additionally, McHardy does not disclose at least one output electrode in contact with said dielectric medium, wherein said plurality of molecular conductors form physical neural connections **when** said dielectric medium is **exposed** an electric field. The synapse of McHardy is only formed after the whiskers are grown according to McHardy's electroplating process, not when Appellant's dielectric medium is exposed to an electric field. This is a subtle but important difference between McHardy and Appellant's claimed invention, because McHardy's whiskers, once they are grown cannot be strengthened or weakened via the electric field or via an altered frequency. Once McHardy's whiskers are grown they are essentially locked into place. The electric field of McHardy is only used as part of McHardy's device to grow the whiskers and not to thereafter strengthen or weaken these whiskers.

Also, McHardy does not teach the use of a dielectric solvent and/or a dielectric solution. The Examiner only argued that the moisture film may be a dielectric, but there is no teaching by McHardy of an actual dielectric solvent or dielectric solution or that the moisture film actually is a dielectric solvent or such a solution. The moisture film of McHardy is clearly not being used as a dielectric in the context of the electroplating process of McHardy.

McHardy additionally provides no disclosure of the strengthening or weakening of neural connections dependent upon the respective strengthening or weakening of an electric field or an alteration of a frequency thereof. The

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Examiner's assertion that applying a voltage across the anode and cathode to create an electric field and an electric field exists where there is current density is not an indication that McHardy's device actually involves the strengthening or weakening of neural connections dependent upon the respective strengthening or weakening of an electric field or an alteration of a frequency thereof.

Based on the foregoing, the Appellant submits that the rejection to claims 17-18 and 20 has been traversed. Appellant respectfully requests allowance of claims 17-18 and 20.

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APPELLANT'S ARGUMENTS REGARDING ISSUE #9 - ARGUMENTS IN SUPPORT OF PATENTABILITY OF CLAIM 19.

Claims 19 is patentable over McHardy in view of Liaw.

Regarding claim 19, the Examiner admitted that McHardy does not teach a learning mechanism for applying Hebbian learning to say physical neural network.

The Examiner asserted, however, that Liaw teaches a learning mechanism for applying Hebbian learning to a physical neural network and cited Liaw, Col. 13, lines 5-18 in support of this assertion.

The Examiner argued that it would have been obvious at the time the invention was made to one of ordinary skill in the art to combine the teachings of McHardy with the learning mechanism for applying Hebbian learning as taught by Liaw for the purpose of having means to govern how the neural network is to adapt its connections to produce a correct input-output mapping.

The Examiner admitted, however, that McHardy in combination with Liaw do not explicitly teach utilizing voltage gradient, voltage gradient dependencies, pre-synaptic and post-synaptic frequencies to implement Hebbian plasticity and anti-Hebbian plasticity.

The Examiner argued that Nervegna teaches Hebbian synapse circuit that utilizes voltage gradient, voltage gradient dependencies, pre-synaptic and post-synaptic frequencies to implement Hebbian plasticity and anti-Hebbian plasticity. The Examiner cited Nervegna, the Abstract; Col. 2, lines 45-64; Col. 3, lines 59-67; Col. 4, lines 1-17, lines 23-67; Col. 5, lines 1-31; FIG. 15, 15A, 15B; and Col. 20, lines 7-15 in support of this argument and asserted that it would have been obvious at the time the invention was made to one of ordinary skill in the art to combine the teachings of McHardy in combination with Liaw with the Hebbian synapse circuit of Nervegna for the purpose of providing neural computation in a manner which is more realistic.

The Appellant disagrees with this assessment and notes that arguments presented above against the rejection to claims 1, 9, and 10 under 35 U.S.C. 103 apply equally against the rejection to claim 18 under 35 U.S.C. 103 as being

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unpatentable over McHardy, and Liaw. In the interest of brevity, these arguments will not be repeated. As such, the Appellant submits that based on these same arguments, the rejection to claim 18 is traversed. The Appellant therefore respectfully requests withdrawal of the aforementioned rejection to claim 18.

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APPELLANT'S ARGUMENTS REGARDING ISSUE #10 - ARGUMENTS IN SUPPORT OF PATENTABILITY OF CLAIMS 1, 11, 15, and 16.

The double patenting rejection to claims 1, 11, 15, and 16 is overcome by the terminal disclaimer included herewith.

Appellant is submitting concurrent with this Appeal Brief, two (2) terminal disclaimers that each fully comply with 37 CFR 3.73 (b). The first terminal disclaimer is submitted with respect to claim 1 and Copending U.S. Patent Application No. 10/969,789; and the second terminal is submitted with respect to claims 11, 15, and 16, and Copending U.S. Patent Application No. 10/735,934. Given the submission of these terminal disclaimers, the Appellant submits that the double patenting rejection to claims 1, 11, 15, and 16 has been overcome. Appellant respectfully requests withdrawal of the aforementioned double patenting rejection.

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SUMMARY OF ARGUMENTS AND CONCLUSION

The appealed claims are not anticipated, disclosed, taught and/or suggested by McHardy, Liaw, Brandes and/or Nervegna.

Appellant respectfully submits that the arguments included herein by Appellant, as well as Appellant's specification and prosecution record support that the claims 1-20 are allowable.

Appellants now respectfully request that the Board reverse the rejections of claims 1-20 and instruct the Examiner to allow such claims.

Respectfully submitted,

Kermit Lopez

Dated: March 12, 2008

Kermit Lopez
Attorney for Appellant
Registration No. 41,953
ORTIZ & LOPEZ, PLLC
P.O. Box 4484
Albuquerque, NM 87196-4484

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VIII. APPENDIX

The following Appendix (VIII) provides a listing of the appealed claims:

1. A system, comprising:

a physical neural network configured utilizing nanotechnology, wherein said physical neural network comprises a plurality of nanoconductors suspended and free to move about in a dielectric medium and which form neural connections between pre-synaptic and post-synaptic components of said physical neural network; and

a learning mechanism for applying Hebbian learning to said physical neural network.

2. The system of claim 1 wherein said learning mechanism utilizes a voltage gradient to implement Hebbian plasticity within said physical neural network.

3. The system of claim 1 wherein said learning mechanism utilizes voltage gradient dependencies associated with physical neural network to implement Hebbian learning within said physical neural network.

4. The system of claim 1 wherein said learning mechanism utilizes pre-synaptic and post-synaptic frequencies to provide Hebbian learning within said physical neural network.

5. The system of claim 1 wherein said learning mechanism utilizes a voltage gradient to implement anti-Hebbian plasticity within said physical neural network.

6. The system of claim 1 wherein said learning mechanism utilizes voltage gradient dependencies associated with physical neural network to implement anti-Hebbian learning within said physical neural network.

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7. The system of claim 1 wherein said learning mechanism utilizes pre-synaptic and post-synaptic frequencies to provide anti-Hebbian learning within said physical neural network.

8. The system of claim 1 wherein said plurality of nanoconductors includes nanoconductors comprising nanotubes.

9. The system of claim 1 wherein said plurality of nanoconductors includes nanoconductors comprising nanowires.

10. The system of claim 1 wherein said plurality of nanoconductors includes nanoconductors comprising nanoparticles.

11. A system, comprising:

a physical neural network configured utilizing nanotechnology, wherein said physical neural network comprises a plurality of nanoconductors suspended and free to move about in a dielectric medium and which form neural connections between pre-synaptic and post-synaptic components of said physical neural network; and

a learning mechanism for applying Hebbian learning to said physical neural network wherein said learning mechanism utilizes a voltage gradient or pre-synaptic and post-synaptic frequencies thereof to implement Hebbian or anti-Hebbian plasticity within said physical neural network.

12. The system of claim 11 wherein said plurality of nanoconductors includes nanoconductors comprising nanotubes.

13. The system of claim 11 wherein said plurality of nanoconductors includes nanoconductors comprising nanowires.

14. The system of claim 11 wherein said plurality of nanoconductors includes nanoconductors comprising nanoparticles.

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15. The system of claim 11 wherein said dielectric medium comprises a dielectric liquid.

16. The system of claim 15 wherein said plurality of nanoconductors form physical neural connections when said dielectric medium is exposed to an electric field, such that said physical neural connections can be strengthened or weakened depending upon a strengthening or weakening of said electric field or an alteration of a frequency thereof.

17. A system, comprising:

a plurality of molecular conductors disposed in and free to move about within a dielectric medium comprising a dielectric solvent or a dielectric solution;

at least one input electrode in contact with said dielectric medium; and

at least one output electrode in contact with said dielectric medium, wherein said plurality of molecular conductors form physical neural connections when said dielectric medium is exposed an electric field across said at least one input electrode and said at least one output electrode, such that said physical neural connections can be strengthened or weakened depending upon a strengthening or weakening of said electric field or an alteration of a frequency thereof.

18. The system of claim 17 further comprising a physical neural network comprising said plurality of molecular conductors disposed within a dielectric medium comprising a dielectric solvent or a dielectric solution, said at least one input electrode in contact with said dielectric medium, and said at least one output electrode in contact with said dielectric medium.

19. The system of claim 18 further comprising a learning mechanism for applying Hebbian learning to said physical neural network wherein said learning mechanism utilizes a voltage gradient or pre-synaptic and post-synaptic frequencies thereof to implement Hebbian or anti-Hebbian plasticity within said physical neural network.

20. The system of claim 18 wherein said physical neural network is configured as an integrated circuit chip utilizing nanotechnology.

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IX. EVIDENCE APPENDIX

U.S. Patent No.	Title
7,107,252	Pattern recognition utilizing a nanotechnology-based neural network
7,039,619	Utilized nanotechnology apparatus using a neural network, a solution and a connection gap
7,028,017	Temporal summation device utilizing nanotechnology
6,995,649	Variable resistor apparatus formed utilizing nanotechnology
6,889,216	Physical neural network design incorporating nanotechnology

X. RELATED PROCEEDINGS APPENDIX

There are currently no related interferences related to the above-referenced patent application. A Notice of Appeal, however, has been filed in U.S. Patent Application Serial No. 10/969,789. A Notice of Appeal and Appeal Brief were also filed in U.S. Patent Application 10/735,934. A Notice of Appeal and Appeal Brief were also filed in U.S. Patent Application 10/748,546, which was reopened and has been allowed as of the date of this Appeal Brief.

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